Investigating the link between symptoms of sleep disturbance and subsequent self-harm risk during adolescence

Kirsten Russell

University of Strathclyde

School of Psychological Sciences and Health

Submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

2020

Author's Declaration

This thesis is the result of the author's original research. It has been composed by the author and has not been previously submitted for examination which has led to the award of a degree.

The copyright of this thesis belongs to the author under the terms of the United Kingdom Copyrights Act as qualified by the University of Strathclyde Regulation 3.50. Due acknowledgement must always be made of the use of any material contained in, or derived from, this thesis.

Signed:

Date:

Acknowledgements

"You know, as you get older, it's not the failures you regret, or the times you made an ass of yourself. It is the times you never even tried, when you just lost your nerve"
– Martin Crane.

Although there is only one name on the front of this thesis, it is very important to acknowledge that (in reality); a PhD student never reaches the finish line on their own, or without ongoing support of an amazing group of people. I am immensely grateful to everyone who has supported me throughout me PhD journey. It is one that I will never forget, and I still feel lucky every single day to have had this incredible opportunity.

Throughout my PhD, I have been very fortunate to have been supervised by the best mentors that I could have asked for, Dr Susan Rasmussen and Dr Simon Hunter. Susan, thank for taking a chance on a random student who contacted you unexpectedly, with a passion for adolescent wellbeing, and her heart absolutely set on becoming a researcher. I am so grateful for all your support, encouragement, and the fact that you have believed in me every single step of the way (even during the times that I no longer believed in myself!). You have provided me with so many amazing opportunities to develop as both a researcher and teacher along the way, and I feel so lucky to have been supervised by such as badass mentor. I have loved each of our travel adventures together and (although they have taken us as far as Oviedo, Ghent, and San Francisco) our Team Rasmussen trip to Harris is the one I remember most fondly.

Simon, thanks for your support throughout this journey, for always emphasising the importance of work-life balance, and for being so patient at the times that I appeared at your office door in a mini stats panic. I will always be in awe of your stats knowledge! I am most grateful to you for providing me with opportunity to work with you as a Research Assistant. It was not until I had that opportunity to briefly step away from my PhD (and tackle another project altogether) that I really grasped the valuable skills that I have gained during my time at Strathclyde.

I really do feel that I have developed so much as a researcher (in terms of both confidence and competence) through having the opportunity to work with you both. Thank you for making the PhD not only an amazing learning experience, but also one that has been so much fun. I cannot remember a meeting where we did not laugh at least once (even if it was at my expense!) and it is largely in part to you both that I have loved my PhD right up to my submission day!

Whilst Strathclyde has provided me with so many fantastic opportunities, I am most grateful to have had the opportunity to have been part of the Team Strathclyde Psychology Postgrad community, and to have made a brilliant group of friends! Thanks to all of you for being epic, for the research and wedding chats, for making late nights and weekends in the grad school bearable, and for all your amazing

support (especially during the final stretch!). Most importantly thanks for all the amazing memories, and for making this undoubtedly my favourite time at University. Gail and Michelle, I am so glad that we have had the chance to write up alongside each other. I could not have reached this stage without you both. Our days in the Mitchell library, putting the world to rights, chatting about true crime, and our post-PhD travel plans have been some of my favourite - and most productive - of my PhD. A particular mention goes to Claire (Dr Wilson) for making me feel so welcome from the moment I anxiously walked through the door of GH593 on my first day, right through to being an amazing friend and excellent support in the final days of my write up. Thanks for the wisdom, the Fiat 500 laughs, and for accompanying me to the gym when I just needed a break away from the laptop. I cannot wait to get to work on the list of research ideas we have been developing since 2014!

During the past few years, I have been lucky enough to become part of an epic community of early career suicide and self-harm researchers. My virtual lab - your insights have been invaluable and your passion is totally inspiring. I really do believe that working together as part of this amazing team, we can make a difference! In particular I have to thank Emma N, Tiago Z & Donna L. Getting to know you all, making fantastic memories, and having the opportunity to work together on developing netECR has been one of the main highlights of my entire PhD and I feel lucky to call you all friends. It has been amazing to see this community grow and I am so proud of what we have achieved together. Thanks for your support, wisdom, inspiration, and ability to find the perfect GIF. I can wait to see where the future takes us all!

To my best friends Emily and Lana, thank you for your endless patience, understanding, and support since I started studying psychology all those years ago. You have always believed in me and I honestly could not have done this without you both! Emily, thank you for creating two epic tiny humans who have increased my motivation to finish this thing way more than you know. I cannot wait to make more memories as a team, and be the best Auntie K that I can be!

Mum, thank you for your unwavering support and for everything you have done to make this challenge as easy as it possibly could be. You have always sensed when I needed a motivational postcard, the superpower of a mum hug, or even just a strong cup of coffee delivered to the flat. I would never have made it to this stage without you. Thank you, it means more than I could ever put into words. Dad, thanks for always believing that I would get there in the end, and being supportive of my dream of becoming a researcher! Maybe we will be able to find time for that coffee now. Greig, thanks for keeping me grounded throughout this process (yes, I do go to uni…!), and for being one of the few people awake to provide encouragement or hilarious selfies when my night owl tendencies had me writing at stupid o'clock in the morning. Thanks for always believing in me when my confidence wavered – you are the best!

Andrew, so much has changed since I started this PhD. I started with journey with a boyfriend, somewhere along the way I became your fiancée, and now (after an epic day at KegFest) I am lucky enough to call you my HusbAndrew. Yet at the same

time, you have not changed at all. You have always been my number one cheerleader and the best friend and teammate anyone could have. You have been there through it all; from driving me to schools in the middle of nowhere, celebrating every tiny milestone, and being there to dance in the kitchen when the stress/exhaustion took over some days. I won't say that I couldn't have done this without you (because I know you'd get annoyed at me for not taking the credit) but I will say that I wouldn't have wanted to. You have gone above and beyond and I will never forget how amazing you have been throughout this whole journey!

I am also extremely grateful to my colleagues at the VRU for listening to my endless PhD chat and for their amazing support during the final push to submission!

Thank you to all the schools, teachers and pupils that have invested time in my research. It would not have been possible without you all, and your contributions have provided key insights that take us a wee step closer to saving the lives of young people.

Finally, I would like to dedicate this thesis to Rena ("Nana") Neill, one of the strongest, funniest and most stubborn women I have ever known. I genuinely believe that I have channelled some of that inherited stubbornness into powering through and not giving up at times when things got challenging over the past few years. You understood my love of research, loved nothing more than having me over to work in your house, and you always believed that I could do this even though it was "all Greek to you!" I really hope I continue to make you proud!

List of Tables

List of Figures

List of Common Abbreviations

AAP = American Academy of Paediatrics

APA = American Psychiatric Association

AASM = American Academy of Sleep Medicine

DDNSI = Disturbing Dreams and Nightmare Severity Index

DIS = Difficulties Initiating Sleep

DMS = Difficulties Maintaining Sleep

EMA = Early Morning Awakening

DSM-V = Diagnostic and Statistical Manual of Mental Disorders, Version 5

DSPD = Delayed Sleep Phase Disorder

IMV = Integrated Motivational Volitional Model of Suicidal Behaviour

ISD = Information Services Division

NSSI = Non-Suicidal Self-Injury

PSQI = Pittsburgh Sleep Quality Index

SCI = Sleep Condition Indicator

SE = Sleep Efficiency

SOL = Sleep Onset Latency

SQ = Sleep Quality

TST = Total Sleep Time

WHO = World Health Organization

Abstract

Adolescence represents a high-risk period for the onset and repetition of self-harm, and evidence suggests that an increasing number of young people are harming themselves. This is concerning as self-harm is indicative of intolerable psychological distress, and young people who harm themselves are at greater risk of suicide in the future. Responding effectively to self-harm is a key component of suicide prevention efforts. A fundamental step in reducing self-harm during adolescence is the identification of factors associated with increased self-harm risk, and clarification regarding the theoretical underpinnings of these relationships.

Increased attention has been placed on adolescent sleep within this context, and research evidence supports a role for symptoms of sleep disturbance within pathways to self-harm. However, important questions about this relationship remain unanswered. This thesis aimed to target key gaps in current understanding, and had two overarching aims. The first aim of this thesis was to provide a more detailed and nuanced understanding the association between specific symptoms of sleep disturbance and future self-harm risk in order to understand which aspects of sleep are driving the relationship. The second aim was to examine the role of theoretically salient psychological factors, which underpin the relationship between disturbed sleep and self-harm in order to understand why the link exists. These aims were addressed by conducting a programme of research including a systematic review, a six-month prospective study, and a micro-longitudinal investigation.

Chapter 3 synthesises and critically evaluates research examining the link between symptoms of sleep disturbance and self-harm risk during adolescence. Global assessments of sleep disturbance, symptoms of sleep disorders and

problems, and specific sleep parameters, are all associated with increased vulnerability to self-harming and suicidal thoughts and behaviours. A research agenda is presented offering recommended directions for future work in the area. Chapter 4 details a six-month prospective study that examines the relationship between a wide range of symptoms of sleep disturbance and subsequent self-harm thoughts and behaviours. Clinically salient insomnia symptoms were prospectively associated with self-ham thoughts. Both insomnia symptoms and poor sleep quality predicted that a young person would engage in first time or repeat self-harm during the six-month follow up period. To establish why this link exists, Chapter 5 examined whether psychological pathways - derived from the Integrated Motivational Volitional Model of Suicidal Behaviour - explain the link between insomnia symptoms and self-harm risk. The relationship was accounted for by perceptions of defeat and internal entrapment (but not external entrapment). Chapter 6 details a micro-longitudinal investigation that aimed to build on the insights gained from the systematic review and six-month prospective study, by examining whether symptoms of sleep disturbance and psychological factors (i.e., defeat, internal entrapment, and external entrapment) predicted short-term self-harm risk. Specific symptoms of sleep disturbance predicted defeat (sleep quality) and internal entrapment (nightmare intensity and distress) the following day, but were not associated with next-day self-harm thoughts and behaviours.

Taken together, the research presented in this thesis provides novel insights into the relationship between sleep disturbance and self-harm risk within the unique context of adolescence. This advanced understanding has implications for future research, theoretical conceptualisation of self-harm risk, and has the potential to guide policy and prevention efforts.

Chapter 1 – Insights into self-harm during adolescence: An overview of prevalence, functions, outcomes, and the role of psychological theory.

1.1. Chapter Overview

In order to provide a context for the investigations presented within the current thesis, this chapter provides an introduction to self-harm during adolescence. Specifically, it will focus on highlighting the scale of this public health problem in young people, the reasons that adolescents harm themselves, and the impact that self-harm can have on clinical and social outcomes. Next, a contemporary psychological model of self-harm (the Integrated Motivational-Volitional Model (O'Connor, 2011; O'Connor & Kirtley, 2018)) is presented as a useful framework for understanding the complex and multifaceted pathways to self-harming thoughts and behaviours. Finally, the theoretical assumptions underpinning the present thesis are discussed.

1.2. The need for self-harm research

Almost 800,000 people die by suicide globally each year and many more attempt to take their own lives (World Health Organisation [WHO], 2018). Last year, 6,507 people died by suicide in Great Britain, with Scotland demonstrating the highest suicide figures in the UK (Office for National Statistics [ONS], 2019). Suicide is the third leading cause of mortality in young people aged 15-29 years worldwide (WHO, 2019), and, as a result, adolescence represents a period of heightened suicide risk. The impact of this loss of life is profound. Behind every person who dies by suicide, there are likely to be family members, friends, teachers, colleagues, and

professionals who are impacted and left in need of support (Cerel et al., 2019).
Those bereaved by suicide exhibit an increased risk of adverse mental health and
social functioning outcomes, as well as being at an elevated risk of suicide
themselves (Pitman, Osborn, King, & Erlangsen, 2014). Given the significant
consequences of each death by suicide at an individual, community and societal
level, policy makers, clinicians, and researchers have identified suicide prevention as
a global health priority.

A crucial step in preventing suicide in young people is developing an
increased understanding of the factors, which lead to these behaviours (Townsend,
2014). Self-harm is common during adolescence and is the single strongest risk
factor for suicide in this population (Hawton, Saunders & O'Connor, 2012; Olfson et
al., 2018). Therefore, advancing understanding of self-harm in young people can be
considered as one crucial strategy in preventing death by suicide in young people in
young people.

1.3. Rationale for a focus on the adolescent population

The present thesis aims to advance understanding of self-harm risk
specifically within the adolescent population, and, in line with the World Health
Organisation (2014), defines adolescence as the developmental period spanning 10
to 19 years old. Adolescence is a particularly relevant context for self-harm research
for three main reasons. First, self-harm emerges as a significant public health
concern during this developmental period (Klonsky & Muehlenkamp, 2007; O'Connor
& Nock, 2014). The average age for the onset of self-harm occurs around age 12-14
years old (Jacobson & Gould, 2007), and rates of this behaviour consistently
demonstrate a peak around 14 -17 years old, before demonstrating a remittance in
early to mid-adulthood (Plener, Schumacher, Munz, & Groschwitz, 2015). Second,

self-harm is common (Hawton et al., 2012; Townsend, 2014) and accounts for a considerable proportion of the disability and mortality burden amongst adolescents worldwide (Gore, Bloem, Patton, Ferguson, Joseph, Coffey et al., 2011). Third, adolescence is a distinct developmental period (WHO, 2014; Blakemore, 2018) that comprises unique and age specific transitions across various interacting domains (e.g., biological, neurodevelopmental, cognitive, and psychosocial) (Steinberg, 2016). Given that adolescence is distinct, it is not appropriate to directly apply findings that have been obtained from adult samples to young people, and it has been hypothesised that the nature of self-harm thoughts and behaviours (and their relationships with risk factors) might change over time (Stewart, Eaddy, Horton, Hughes, & Kennard, 2017). Taken together, these findings suggest that conducting investigations during this high-risk period will be fundamental in providing the insights required to develop evidence-based early intervention and prevention strategies.

1.4.   What is self-harm?

Despite an increasing focus on self-harm worldwide, there is still a lack of consensus about how self-harm thoughts and behaviours should be conceptualised. This inconsistency in terminology represents one of the central challenges within the self-harm literature, and hinders progress within this field of research by making it difficult to accurately determine prevalence rates, gender differences, risk factors, and underlying motivations (Nock, 2010; Silverman, 2016). This information is key to education, prevention, and intervention strategies. At the forefront of the debate regarding the definition of self-harm is disagreement between researchers about the extent to which these acts are most accurately conceptualised as a categorical or dimensional construct (Kapur, O'Connor, & Hawton, 2013; Silverman, 2016).

Specifically, there is a lack of consensus as to whether it is meaningful, or even possible, to classify or distinguish acts of self-harm based on the presence or absence of an individual's intention to die as a consequence of the behaviour. That is to say that some researchers argue that self-harm associated with suicidal intent (i.e., a suicide attempt) is distinct from self-harm without suicidal intent (i.e., non-suicidal self-injury: NSSI) (Butler & Malone, 2013). Alternatively, others argue that the intentions and motivations underlying self-harm are complex and fluid, such that categorical distinctions are not useful, and a broader conceptualisation of self-harm (irrespective of motivation) is necessary (Kapur et al., 2013).

Whilst issues of nomenclature have long been present within the international self-harm research community, this debate has escalated following the inclusion of Non-Suicidal Self-Injury and Suicidal Behaviour Disorder in the DSM-V as conditions for further study (American Psychiatric Association [APA], 2013). In the United States, the term NSSI is favoured by researchers and clinicians, and is defined as any intentional self-inflicted damage to the surface of an individual's body without conscious suicidal intent (American Psychiatric Association [APA], 2013). This definition excludes those who have taken an overdose, despite evidence suggesting that individuals who engage in self-poisoning often endorse no suicidal intent in relation to this behaviour (Hawton, Harriss, & Rodham, 2010; O'Connor et al., 2007). Critics of this approach raise further concerns, and provide evidence to suggest that individuals may not necessarily fit into the discrete (non-suicidal vs. suicidal self-injury) categories (Kapur et al., 2013) that are driven by the presence or absence of suicidal intent.

It has been argued by researchers in Europe that the "non-suicidal" prefix is misrepresentative of these behaviours (Kapur et al., 2013). Many individuals who

have engaged in NSSI behaviours also report experiencing suicidal thoughts and/or a history of attempted suicide (Klonsky & Glenn, 2009; Klonsky, 2011). As such, non-suicidal and suicidal thoughts and behaviours can co-occur in the same individual, with NSSI representing one of the strongest risk factors for future suicide attempts in young people (Andover, Morris, Wren, & Bruzzess, 2012; Whitlock et al., 2013). In addition, there is often uncertainty and/or ambivalence regarding suicidal intent in relation to acts of self-harm (Brunner et al., 2014). Identifying whether an individual's intention was to take their own life is further complicated by evidence suggesting that young people often report multiple motivations driving their engagement in self-injurious acts (Rasmussen, Hawton, Philpott-Morgan, & O'Connor, 2016), and that the motivations and methods characterising self-harm can change over time (Owens et al., 2015). For example, a recent study investigating the factors contributing to an episode of self-harm in young people aged 13 to 21, highlighted that "wanting to die" was endorsed frequently in relation to the most recent episode, but not the first occurrence, of self-harm (Townsend et al., 2016). Finally, evidence gained from a taxometric analysis supports the assertion that self-harm occurs on a continuum, and that the presence or absence of suicidal intent does not represent naturally occurring categorical distinctions (Orlando, Broman-Fulks, Whitlock, Curtin, & Michael, 2015).

As a result of the complexity and uncertainty regarding intent, the strong association between self-harm and suicide, and the fluctuating nature of self-harm motivations and methods, researchers in Europe primarily advocate the use of the term self-harm (Silverman, 2016). This construct is characterised by a broader definition, which encompasses any type of (non-fatal) intentional self-injury or self-injurious behaviour irrespective of suicidal intent (Hawton et al., 2003). Behaviours

include, but are not limited to, cutting, burning, scratching, and ingestion of prescription/non-prescription substances in excess of the recommended dosage (Hawton, Rodham, Evans, & Weatherall, 2002).

The current thesis will employ this broader operationalisation of self-harm, as this is consistent with national clinical guidelines for the management of self-harm (National Institute for Health and Care Excellence [NICE], 2004, 2011). This approach was taken to ensure that the findings presented within this thesis have the potential to inform decision-making regarding clinical practice and policy at a national level, and ultimately help to support young people at risk of self-harm. Given the issues facing this field of research in terms of the conceptualisation of self-harm, the literature reviewed within the present thesis will draw from a broad range of evidence from both clinical and community adolescent samples, including research examining non-suicidal, suicidal and self-harming thoughts and behaviours. Where relevant, the specific terminology employed in individual studies will be reported. However, for the purposes of consistency, this thesis will largely apply the term self-harm.

1.5.   How many young people engage in self-harm?

Owing in part to a lack of a standard nomenclature for self-harm, and the fact that researchers and clinicians within this discipline are not always speaking the same scientific language (Silverman, 2016), systematic comparisons between studies are often not possible. Estimated prevalence rates vary widely between investigations, and, as a consequence, it is challenging to obtain an accurate and concrete picture of the international prevalence of self-harm thoughts and behaviours in adolescents. What is clear, however, is that self-harm in young people is a significant public health problem of considerable scale (Brunner et al., 2014; Kokkevi, Rotsikam, Arapaki, & Richardson, 2012; Madge et al., 2008).

Research has consistently demonstrated that the vast majority of adolescent self-harm occurs "hidden" in the community, and does not come to the attention of clinical services (Fortune, Sinclair, Hawton, 2008; Ystgaard et al., 2009; Madge et al., 2008). As a result, it has been proposed that fatal and non-fatal self-harm can be conceptualised in terms of an iceberg model (Figure 1.1) with three levels (Hawton et al., 2012; McMahon et al., 2014). The tip of the iceberg represents the highly visible but relatively uncommon event of fatal self-harm (i.e. suicide) followed by the more frequent occurrence of hospital treated non-fatal self-harm. The submerged base of the iceberg symbolises the very common, but often hidden, phenomenon of self-harm, which occurs in the community and does not result in presentation to clinical services (Geulayov et al., 2018; McMahon et al., 2014). The hidden nature of the majority of self-harm, alongside the reported differences between young people who do and do not present to health services after harming themselves (Hawton, Rodham, Evans, & Harriss, 2009; Rodham, Hawton, & Evans, 2004), highlights the need for community-based research and prevention efforts.
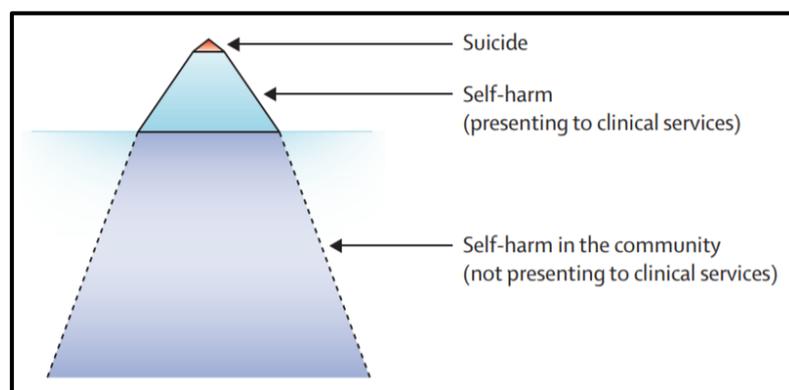
Figure 1. 1. Representation of the iceberg model of fatal and non-fatal self-harm (Hawton, Saunders, & O'Connor, 2012)

School and community-based investigations from across the world have highlighted the extent to which adolescents engage in self-harm thoughts and behaviours at a community level (Brunner et al., 2014; Kokkevi et al., 2012; Madge

et al., 2008). In recognition of the lack of reliable information concerning the prevalence of self-harm among young people, and the difficulties surrounding international comparisons of self-harm rates, the Child and Adolescent Self-harm in Europe (CASE) study was developed (Madge et al., 2008). This large-scale (n=30,477) cross-sectional examination of young people included adolescents from seven participating countries (Australia, Belgium, England, Hungary, Ireland, Norway, and The Netherlands), and implemented a standardised methodology across each centre. The researchers employed strict criteria for the classification of self-harm to allow for the collection of reliable prevalence data and meaningful comparisons across countries. This study methodology has since been replicated in Scotland and Northern Ireland (O'Connor, Rasmussen, Miles & Hawton, 2009; O'Connor, Rasmussen, & Hawton, 2014). Pooled prevalence data from the original CASE study highlighted an average lifetime prevalence rate of self-harm of 17.8% (13.5% for females and 4.3% for males), with 11.5% of young people reporting having engaged in acts of self-harm in the 12 months prior to the survey (8.9% for females and 2.6% for males) (Madge et al., 2008).

In addition, the results of this international survey indicated that more adolescents had seriously thought about taking an overdose or trying to harm themselves than had actually acted on these thoughts. Almost 10% of males and over 20% of females reported having thought about engaging in self-harm during the past year, but had not actually done so. Notably, the authors highlight that rates vary across countries, and acknowledge that these prevalence rates may be underestimations of the true extent of self-harm in the community, as young people engaging in self-harm are more likely to be absent from school (Bjarnason & Thorlindsson, 1994; Epstein et al., 2019). Two European multi-centre investigations

reinforce the findings from the CASE study and highlight that self-harm represents a significant international problem (Brunner et al., 2014; Kokkevi et al., 2012).

Evidence collected from both clinical and community samples has demonstrated that repetition of self-harm is common amongst the adolescent population (Hawton, Fagg, Simkin, Bale, & Bond, 2000; Hawton et al., 2012; Madge et al., 2008, O'Connor et al., 2009). Results from the CASE study highlighted that more than half of the young people that met the criteria for a self-harm episode in the past year had already harmed themselves previously on at least one other occasion. Hospital-based studies reinforce these findings and demonstrate that repetition is most likely to occur in the days or weeks following the index episode (Perry et al., 2012). Repetition of self-harm is more common in those who engage in self-cutting, or acts involving multiple methods, relative to self-poisoning (Madge et al., 2008). The repetition of self-harm is problematic as it indicates persistent or recurrent psychological distress and is a key predictor of completed suicide (Hawton et al., 2015; Owens, Horrocks, & House, 2002).

1.6.   To what extent is self-harm a problem in Scotland?

National statistics show that Scotland (at 16.1 deaths per 100,000 persons) has the highest suicide rate in the United Kingdom (ONS, 2019), with 784 probable suicide deaths recorded in 2018 (Information Services Division [ISD], 2019). Last year a 15% increase was reported in suicide rates in Scotland (Information Services Division [ISD], 2019) and the leading cause of mortality in people aged 15 to 34 years old is suicide (Information Services Division [ISD], 2016). Consequently, suicide prevention has been identified by The Scottish Government as a national health priority. Scotland's Suicide Prevention Action Plan "Every Life Matters" was published in August 2018 with the aim of reducing suicide by 20% by 2020 (Scottish

Government, 2018). One strategic aim within this action plan delineates a specific commitment to ensuring the needs of children and young people are met in the implementation of suicide prevention activities.

Despite the fact that suicide rates in Scotland are higher than the rest of the United Kingdom, and that many people who die by suicide have a history of self-harm, few studies have investigated self-harm among adolescents in Scotland. In 2009, O'Connor and colleagues noted that almost 14% of Scottish young people reported at least one episode of self-harm during their lifetime, the majority of whom had harmed themselves within the past year (71%). Further, 1 in 7 of the young people participating in the study endorsed experiencing serious thoughts of self-harm in the past year (without acting on them). As such, it is clear that self-harm is common amongst adolescents in Scotland. These findings were reinforced by a more recent school based study, which demonstrated that 1 in 8 young people in Scotland reported having a history of engaging in self-harm (Quigley, Rasmussen, & McAlaney, 2017).

Most recently, findings from the Scottish Wellbeing Study, which involved interviews with a nationally representative sample of over 3000 young adults aged 18-34 years old, demonstrated that 11% of young adults report having attempted suicide and 16% endorse a history of harming themselves without suicidal intent (O'Connor, Wetherall, Cleare, & Eschle, 2018). Notably, 6.5% of the sample had engaged in both non-suicidal self-harm and attempted suicide on at least one occasion, and the average age of onset occurred during adolescence (16.05 years and 17.81 years respectively). These findings highlight the considerable scale of self-harm (with and without suicidal intent) in Scotland, and highlight the need for early intervention during adolescence.

1.7. Why do adolescents engage in self-harm?

In order to understand self-harm, it is important to consider the functions that it may serve for adolescents and the reasons that they engage in these acts. Evidence consistently suggests that there are multiple motivations behind adolescent self-harm, and that many young people harm themselves to cope with distress and to escape unbearable psychological pain (Rodham et al., 2004; Madge et al., 2008; Rasmussen et al., 2016; Scoliers et al., 2009). For example, in 2009, Scoliers and colleagues examined reasons for self-harm in a large-scale school based sample (n=30,477) using the anonymous CASE survey data. Two overarching dimensions of motives were investigated; one, which reflects externally directed "cry for help" reasons (e.g., "I wanted to get some attention") and another characterised by internally directed "cry of pain" motives (e.g., "I wanted to get relief from a terrible state of mind"). Adolescents were significantly more likely to report wanting to escape, die, or get relief from their situation than they were to endorse externally directed reasons such as manipulating or punishing others. This pattern of results was replicated in young people aged 14-16 years old in Northern Ireland (Rasmussen et al., 2016). These data, alongside the finding that "wanting to get relief from a terrible state of mind" was the most commonly endorsed reason, contradicts the perception that adolescent self-harm is simply a cry for help, which is in stark contrast with the views often expressed by health professionals (Hawton, Cole, O'Grady, & Osborn, 1982; McCann, Clark, McConnachie, & Harvey, 2007).

In a novel extension of previous findings, Rasmussen and colleagues (2016) demonstrated that adolescents who endorsed "wanting to get relief from a terrible state of mind" were significantly more likely to engage in self-harm during the six month follow-up period than those who did not indicate this motive. These findings

support the assertion that self-harm may have an affective-regulatory function (Klonsky, 2007; Laye-Gindhu, & Schonert-Reichl, 2005; Nock & Prinstein, 2004; Nock, Prinstein, & Sterba, 2009b). This investigation also provided evidence to support the presence of gender differences in reasons for self-harm. Girls were more likely to report "wanting to die" whilst boys were more likely to endorse the communicative "wanting to frighten someone" motive. The authors suggest that these gender differences could be related to differences in socialisation trajectories between males and females, in that girls may be more likely to internalise their feelings, whilst boys are more likely to externalise distress and direct it outwards. These findings are key to understanding why young people intentionally harm themselves, which is particularly valuable both clinically and theoretically.

1.8.   What are the outcomes of adolescent self-harm?

Evidence suggests that, for the majority of young people, self-harm will cease in late adolescence or early adulthood. An investigation of the natural history of self-harm demonstrated that young women were more likely to continue engaging in these behaviours than young men (Moran et al., 2012). This population-based study also highlighted that persistence of self-harm into adulthood was more likely in those who reported harming themselves on more than one occasion throughout adolescence. Whilst most self-harm will spontaneously resolve, young people who engage in these acts demonstrate elevated vulnerability to a range of adverse outcomes in early adulthood and later in life (Borschmann et al., 2017; Mars, 2014; Moran et al., 2012; Moran et al., 2015). Notably, self-harm thoughts and behaviours are strongly associated with death by suicide (Castellví et al., 2017).

In analysing data from the Avon Longitudinal Study of Parents and Children (ALSPAC) population birth cohort, Mars and colleagues (2014) demonstrated that

young people who engage in self-harm before the age of 16 were more likely to report poorer mental health outcomes such as depression and anxiety at the age of 18. Further, those reporting a history of harming themselves during adolescence were at increased risk of substance use disorders, and were less likely to be in education, training or employment at age 19, than those who had not engaged in self-harm. A recent investigation suggests that this increased vulnerability to adverse psychosocial outcomes persists into the fourth decade of life, such that adolescents who self-harm demonstrate an increased risk of anxiety, substance use and social disadvantage (e.g., greater financial hardship) in their mid-thirties (Borschmann et al., 2017). It is notable, however, that these relationships appear to be largely driven by mental health problems and substance use during adolescence. Nonetheless, these findings demonstrate that young people who self-harm remain a vulnerable group of individuals beyond their teenage years.

The adverse effects of self-harm are not restricted to the adolescent themselves, and these behaviours can have an extensive impact on family members, friends, peers, and communities (Cerel et al., 2019). A qualitative investigation exploring the emotional, physical and practical effects of adolescent self-harm on the family, reported that stress, anxiety, depression, and financial difficulties were common amongst parents (Ferrey et al., 2016). Parents often reported a desire to keep their child's self-harm a secret because of the perceived stigma associated with these acts, and this often resulted in feelings of social isolation and loneliness. Family and friends of adolescents who self-harm may also be at an increased risk of harming themselves as exposure to self-harm is a strong risk factor for non-fatal and fatal self-harm (O'Connor et al., 2009; Mars et al., 2019). Further, family members and friends who have been bereaved by suicide are more

likely to experience a range of negative health and social outcomes (Pittman et al., 2014). Taken together the findings highlight that adolescent self-harm is associated with a variety of adverse consequences and emphasises that family members and friends are also in need of support.

1.9. The Integrated Motivational Model of Suicidal Behaviour: A theoretical perspective on self-harm

The ultimate goal of self-harm research is to prevent people from harming themselves. However, despite over 50 years of research focussing on the investigation of risk factors for self-harm, it remains difficult to predict who will intentionally harm themselves or die by suicide (Franklin et al., 2017). In order to drive progress in this field and shape our understanding of the suicide and self-harm process, several theoretical models have been proposed (O'Connor, & Nock, 2014; O'Connor, Cleare, Eschle, Wetherall, & Kirtley, 2016). Notably, the emergence of more integrative psychological models of suicide and self-harm, which account for the complex interplay between biological, social, psychological, and environmental factors, has recently been highlighted as one of the most exciting developments in this research field (O'Connor & Portzky, 2018a). To date, the most comprehensive model of suicide and self-harm is the Integrated Motivational Model of Suicidal Behaviour (IMV; O'Connor, 2011; O'Connor, & Kirtley, 2018). The IMV has advanced the theoretical conceptualisation of self-harm in two main ways.

Firstly, prior to the development of the IMV, predictive models of suicide and self-harm were narrow in focus, did not account for the complex and multifaceted nature of self-harm pathways, and did not synthesise or build upon the ever growing evidence base concerning self-harm risk (O'Connor et al., 2016). In recognition of these limitations, O'Connor (2011) integrated empirically supported components,

from predominant psychological models of suicide and self-harm, to provide a detailed account of the pathways and processes involved in the development of self-harm thoughts (Figure 1.2). This is advantageous as the model presents several testable pathways, which highlight opportunities for conducting theory-driven research, and could ultimately inform the development of effective, targeted interventions.

Secondly, although more young people will think about self-harm than will go on to harm themselves (Madge et al., 2008; Kokkevi et al., 2012), the majority of self-harm theory has failed to make predictions about which factors are specifically associated with self-harm thoughts vs. behaviours. As a result, there are many gaps in terms of what we know about the transition from thoughts to action, and predicting which adolescents will engage in fatal and non-fatal self-harm remains one of the biggest challenges for clinicians and researchers (Klonsky & May, 2014; O'Connor & Nock, 2014). The IMV encourages progress in this respect by presenting the formation of self-harm thoughts and the progression from thoughts to self-harm acts, as distinct processes with distinct explanations and predictors. This is consistent with the Theory of Planned Behaviour (TPB, Ajzen, 1991), a socio-cognitive model of behaviour, which provides the unifying framework for the IMV.

According to the model, the self-harm pathway can be broken down into three phases: pre-motivational phase (background and triggering factors), motivational phase (formation of thoughts/intention), and volitional phase (behavioural enaction). In being guided by an "ideation to action" framework (Klonsky, Saffer, & Bryan, 2018), the model advances understanding of the factors, which govern the transition from thoughts to behaviour (i.e. key drivers of behavioural enaction). This knowledge is vital in predicting who will harm themselves or attempt suicide. Further, it provides

the opportunity to tailor intervention or prevention efforts to the phase of the model that an individual is currently within. Although the model was developed with suicidal behaviour in mind, the IMV can be applied to non-fatal self-harm (irrespective of motivation) (O'Connor et al., 2016; O'Connor & Kirtley, 2018).
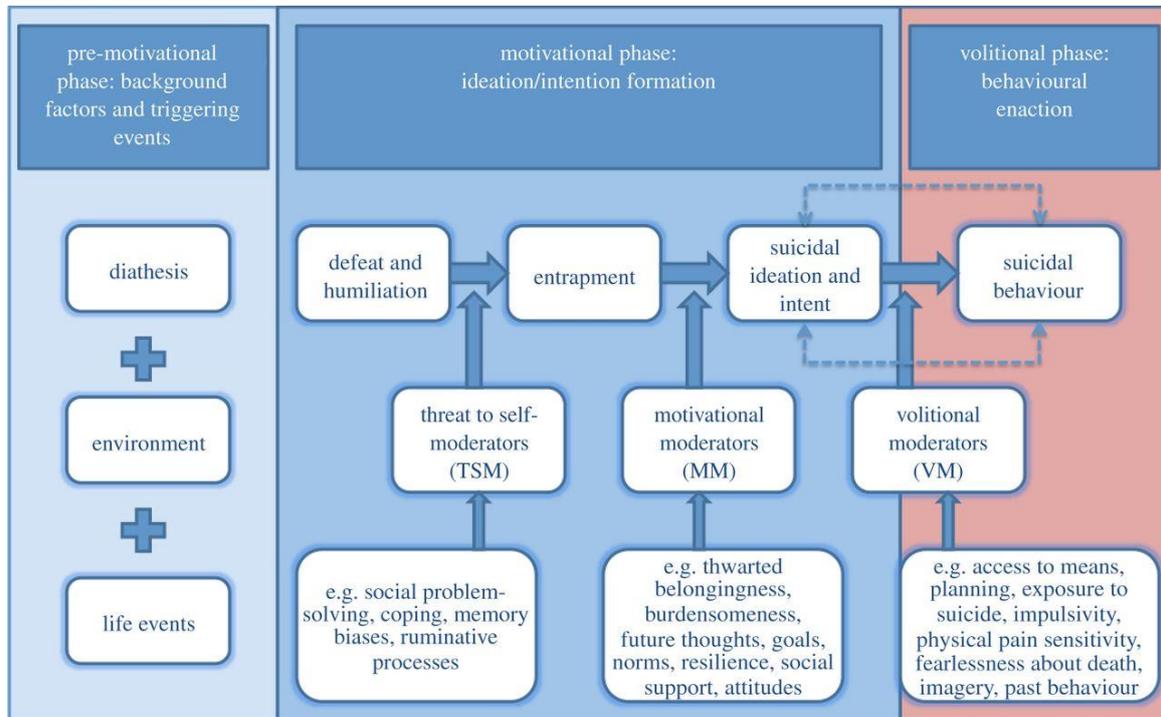
Figure 1. 2. A visual representation of the Integrated Motivation-Volitional Model of Suicidal Behaviour (IMV; O'Connor, 2011; O'Connor & Kirtley, 2018)

1.9.1. Pre-motivational phase

The pre-motivational phase outlines the broader biopsychosocial context in which self-harm thoughts and behaviours emerge, and is guided by a diathesis stress framework. According to this phase of the IMV, self-harm thoughts arise as a result of an interaction between predisposing vulnerabilities and stress inducing factors. It is hypothesised that each individual has a certain level of pre-existing background vulnerability to self-harm thoughts (which is determined by biological, genetic, and cognitive factors), but that the intention to harm oneself will not emerge unless this vulnerability becomes activated or exacerbated in the presence of

stressors. These triggering factors may take the form of environmental influences (e.g., socioeconomic deprivation) and/or stressful life events (e.g., adverse childhood experiences and interpersonal relationship problems). The overarching principle of the IMV is that background factors and triggering events within the pre-motivational phase, exert their effect on self-harm risk via the constructs within the motivational and volitional phases (O'Connor & Kirtley, 2018).

1.9.2. Motivational phase

Another key premise of the IMV is that the proximal predictor of self-harm behaviour is the intention (i.e. desire) to engage in acts of self-harm. The motivational phase describes *how* and *why* an individual's intention to engage in self-harm may emerge, and was heavily influenced by Williams' (2001) Cry of Pain Model. This phase of the framework postulates that the initiation of suicidal ideation or intent is driven by perceptions of defeat and entrapment, also known as threat to self-appraisals. The presence of pre-existing vulnerability factors (such as socially prescribed perfectionism and lower self-esteem) increases sensitivity to these appraisals. In other words, the interaction between background factors and stressful life events can contribute to feelings of defeat (described as the perception of failed struggle, feelings of powerlessness, and a sense of losing social status) (Gilbert & Allan, 1998). For example, if a young person with increased socially prescribed perfectionism (i.e. the unrealistic belief that others expect perfection from them; Hewitt & Flett, 1991) struggles with their schoolwork, they may feel defeated or humiliated as a result.

Sensitivity to perceptions of defeat can trigger feelings of entrapment. Feelings of entrapment are most commonly assessed using a self-report instrument called

The Entrapment Scale (Gilbert & Allen, 1998). Entrapment was initially described as having two components – internal entrapment, which refers to feeling trapped by internal thoughts and feelings, and external entrapment, which occurs due to a desire to escape experiences in the outside world. However, subsequent research has demonstrated inconsistent results concerning the structure of this construct. Whilst some research suggests that entrapment may be best conceptualised as a unidimensional construct (Tucker, O'Connor, & Wingate, 2016), more recent work has suggested that internal and external entrapment should be investigated separately. The need to examine these sub-dimensions is driven by research indicating that internal entrapment is more clearly linked with suicidal ideation than is external entrapment (Owen, Dempsey, Jones, & Gooding, 2018; Cramer, Rasmussen, & Tucker, 2019).

The transition from perceptions of defeat to entrapment is not inevitable, however. The likelihood of this progression can be facilitated or obstructed depending on the presence of factors known as "threat to self-moderators" (e.g., poor problem solving skills or rumination). Evidence suggests that perceptions of internal and external entrapment increase self-harm risk (O'Connor & Portzky, 2018b). However, this relationship may be enhanced or attenuated in the presence, or absence, of motivational moderators such as social support, perceived feeling like a burden to other people (perceived burdensomeness), or where the need to belong is not met (thwarted belongingness). Therefore, the perception of being trapped is not guaranteed to lead to the emergence of self-harm thoughts.

In summary, thoughts of self-harm emerge from feelings of entrapment where acts of self-harm are seen as the salient solution to defeating life circumstances. However, key transitions depend on the presence/absence of stage specific

moderators. Notably, motivational phase variables do not distinguish between those who think about self-harm but do not act on their thoughts, and those who engage in acts of self-harm. However, there are significant differences between pre-motivational and motivational phase variables between those who do and do not have a history of self-harm thoughts and/or behaviours.

1.9.3. Volitional phase

The final phase of the model conceptualises the transition from self-harm thoughts to behaviour, and is arguably the most critical part of the model. The shift from thinking about self-harm, to engaging in self-harm behaviour is governed by volitional-phase moderators. These can be environmental (e.g., access to means), psychological (e.g., impulsivity), social (e.g., exposure to others self-harm), or physiological (e.g., physical pain sensitivity/endurance) in nature (O'Connor & Kirtley, 2018). Variables within this phase of the tri-partite model will differentiate between those who have experienced self-harm ideation (but not acted on their thoughts) and those who have a history of harming themselves.

The IMV model was refined in 2018 (O'Connor & Kirtley, 2018), and now recognises the dynamic and cyclical nature of the transition between self-harm thoughts and behaviour (indicated by bidirectional arrows linking the motivational and volitional phases in Figure 1.2). This addition was grounded in the evidence-based assumption that people who have engaged in self-harm previously are significantly more likely to harm themselves again. A history of self-harm represents another of the volitional moderators. As such, those with a history of self-harm have acquired capability, and may bypass the intention formation stage of the model. Further, in the refined specification of the model, the number of volitional moderators

featuring in the model has now expanded to eight (Figure 1.3). As a result, the IMV

model provides a more detailed account of different factors that govern the transition

from suicidal thoughts to behaviours than any previous models.
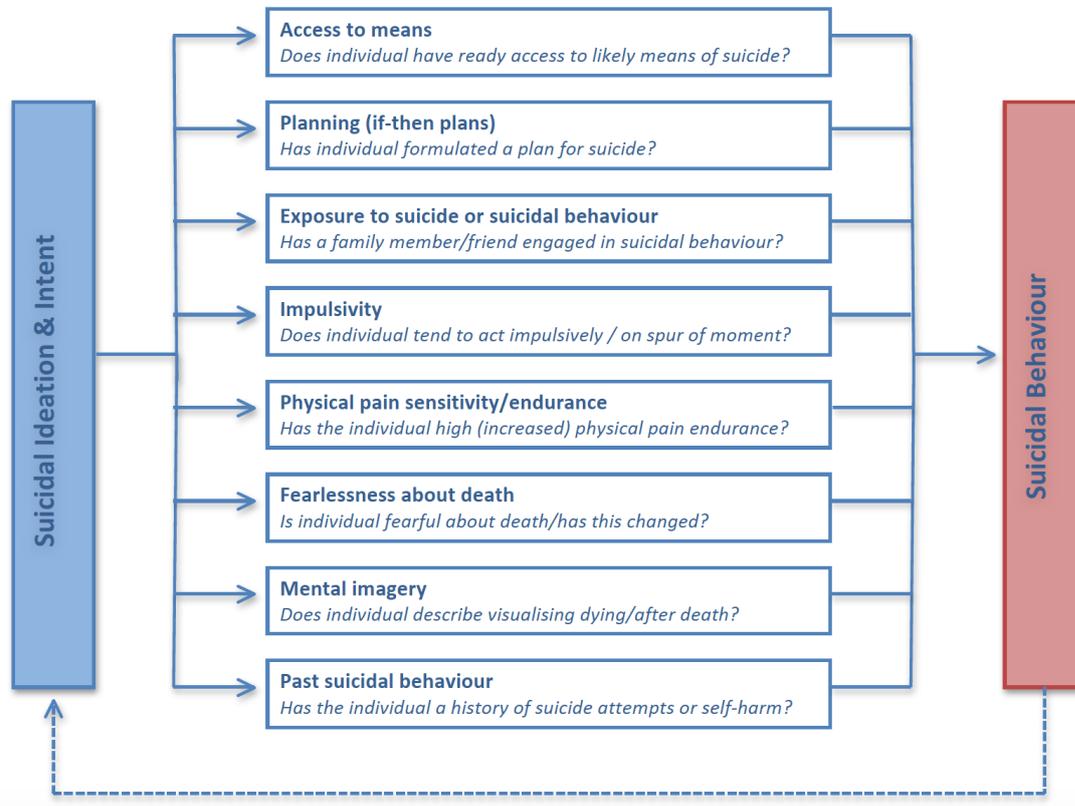
Figure 1. 3. A visual representation of the volitional moderators within the IMV model (O'Connor & Kirtley, 2018).

1.9.4. The role of the Integrated Motivational Volitional Model within the current thesis

Whilst the IMV model provides the most comprehensive account to date of the

processes involved in the development of self-harm thoughts and behaviours, it is

still relatively new and, therefore, not exhaustive. Discovering which factors are

associated with increased risk of self-harm in young people, and why, is key to

understanding and preventing self-harm in this population (Fliege, Lee, Grimm, &

Klapp, 2009). As a result, there is a need to investigate the role of novel and

modifiable risk factors within the context of the IMV, with the aim of refining the

existing framework. Testing empirically driven models of how and why risk factors contribute to risk of self-harm was highlighted as one of the most important future research directions for this decade (Brent, 2011; Nock, 2009a; Nock, 2012; O'Connor, 2011). Given that adolescent sleep is crucial for healthy functioning across a range of developmental domains (Shochat, Cohen-Zion, & Tzischinsky, 2014), one modifiable risk factor that warrants further research attention is sleep disturbance. Consequently, the research presented within the current thesis aims to advance understanding of the relationship between symptoms of sleep disturbance and self-harm risk in young people.

Whilst sleep problems are not explicitly included within current theoretical models, there has been growing interest in the relationship between sleep disturbance and suicide risk across the life span (Bishop, Simons, King, & Pigeon, 2016; Liu et al., 2019). A robust body of evidence supports this link (Bernert, Kim, Iwata, & Perlis, 2015; Littlewood, Kyle, Pratt, Peters & Gooding, 2017; Pigeon, Pinquart, & Conner, 2012; Russell et al., 2019). Whilst findings suggest that symptoms of sleep disturbance confer increased risk for suicidal thoughts and behaviour, investigations concerning self-harm irrespective of motivation are sparse. Initial cross-sectional evidence (Hysing, Sivertsen, Stormark, & O'Connor, 2015; Wong, Brower & Zucker, 2011) suggests that young people who report sleep disturbance are at elevated risk of self-harm. However, it is not yet clear whether these findings replicate prospectively or which psychological factors may account for the relationship. Therefore, one of the main aims of the current thesis is to test predictions, derived from the IMV, in order to advance understanding as to why symptoms of sleep disturbance confer increased risk for future self-harm.

The decision to apply the IMV, rather than competing models of self-harm, was deemed appropriate for two main reasons. First, the IMV is advantageous within this context as it generates a number of testable hypotheses, which provides the opportunity to test theory-driven pathways between sleep disturbances and self-harm risk in young people. More specifically, the IMV highlights a number of candidate mediators (i.e. defeat and entrapment), which may account for this relationship. By identifying these psychological mechanisms as potential clinical targets, the IMV may aid the development of interventions to prevent self-harm in the future. Second, evidence to support the central tenants of the model is growing (O'Connor & Kirtley, 2018), and the utility of the IMV as a framework to inform suicide prevention policies and activities has been highlighted both nationally and internationally (O'Connor et al., 2016).

1.8.5. Empirical support for the IMV and its components

There is growing empirical evidence for the pathways and processes described in the IMV (O'Connor et al., 2016; O'Connor & Kirtley, 2018). At its core, the IMV hypothesises that defeat and entrapment are key drivers of self-harm (with and without suicidal intent). Meta-analytic data supports this assertion by demonstrating that perceptions of defeat and entrapment are robust predictors of suicidal thoughts and behaviours (Siddaway et al., 2015). Further, patients admitted to hospital after an episode of self-harm report significantly higher levels of perceived defeat and entrapment than hospital controls (Rasmussen et al., 2010).

Another key premise of the IMV is that entrapment bridges the association between the experience of defeat and the emergence of suicidal and self-harming thoughts. Both cross-sectional and longitudinal findings provide evidence consistent

with this hypothesised pathway, by indicating that defeat predicts suicidal ideation via increased perceptions of entrapment (Branley-Bell et al, 2019; Owen et al., 2018; Rasmussen et al., 2010; Wetherall, Robb, & O'Connor, 2019). It should be noted, however, that whilst there is robust evidence for the role of defeat and entrapment within the psychological pathways to suicide and self-harm in adults, these links have not yet been investigated in adolescents. Given that adolescence represents a high-risk period for the onset and repetition of self-harm, there is a need to investigate the interrelationships between defeat, entrapment, and self-harm risk during this developmental period.

According to the IMV, variables that predict the emergence of self-harm thoughts (motivational phase factors) are distinct from those that govern whether an individual will act on their desire to harm themselves (volitional phase factors). Specifically, the model hypothesises that people who have thought about self-harm, or have harmed themselves would exhibit significantly higher levels of motivational and volitional-phase variables than those with no history of self-harming thoughts or behaviours. Moreover, the framework indicates that volitional phase variables should distinguish between those who have only thought about self-harm and those who have engaged in self-harm behaviour (i.e. ideation vs. enaction). Several investigations have yielded evidence consistent with these predictions, and demonstrate the utility of volitional moderators in differentiating individuals with a history of self-harm thoughts vs. acts of self--harm (Branley-Bell et al., 2019; Dhingra, Boduszek, & O'Connor, 2016; Mars et al., 2019; O'Connor et al., 2012, Wetherall et al., 2018)

Only one investigation has tested these predictions within an adolescent sample (O'Connor et al., 2012). These findings provided support for the applicability

of the IMV in understanding self-harm pathways in young people. More specifically, pre-motivational and motivational phase variables (i.e., socially prescribed perfectionism, brooding rumination, optimism and self-esteem) did not distinguish between adolescents who had thought about self-harm, but not acted on these thoughts, and young people who had actively engaged in self-harm. Conversely, the volitional phase factors (i.e., self-harm by family/friends, impulsivity, and descriptive norms) did differentiate between these young people. Of these variables, exposure to self-harm in the family or by a close friend most clearly differentiated between groups. This finding has recently been replicated, such that exposure to the self-harm of others was key to distinguishing between young people who had attempted suicide compared to those who had thought about - but not made - a suicide attempt (Mars et al., 2019). However, caution is necessary when interpreting these findings, as investigations have been exclusively cross-sectional in nature.

Taken together, empirical tests of the IMV suggest that the model provides a useful framework for understanding the complexity of self-harm pathways. As a result, it provides a strong foundation that future investigations should seek to build upon. For example, there is a need for investigations that aim to test the core components of the model in adolescents (i.e. the interrelationships between defeat, entrapment and self-harm risk). Further, the examination of novel risk factors, using a theory-driven approach, is necessary to extend the framework. Consequently, the research presented within the current thesis will examine the role of symptoms of adolescent sleep disturbance in the onset and maintenance of self-harm risk, from the viewpoint of the IMV.

1.10. Key points from Chapter 1:

1. Self-harm (defined as self-injury or self-poisoning irrespective of the apparent purpose of the act) is a significant public health issue, and prevention has been highlighted as a priority both nationally and internationally.

2. A lack of consensus regarding the operationalisation and measurement of self-harm is one of the principal challenges facing researchers and clinicians in this area.

3. Evidence consistently suggests that there are multiple motivations behind adolescent self-harm and that most people who harm themselves will do so to cope with distress and intolerable psychological pain.

4. Self-harm is associated with a variety of adverse clinical and social outcomes.

5. A greater understanding of complex and multifaceted nature of self-harm pathways is important clinically (for identifying and treating these behaviours), scientifically (to inform theoretical conceptualisations of self-harm) and from a policy perspective.

6. The IMV is the most comprehensive account of self-harm risk to date and proposes that the self-harm pathway can be mapped across three phases (pre-motivational, motivational, and volitional).

7. There is growing evidence for the pathways and processes described in the model, but future research is required to investigate the core features of the

IMV in adolescents, and to extend the model by through the identification of novel and modifiable risk factors.

1.11. Next steps:

Sleep problems are not included in the IMV but there is a growing interest in the role of symptoms of sleep disturbance in relation to suicide risk. Both sleep problems and self-harm are particularly common during adolescence. However, research examining whether sleep problems confer increased risk for self-harm more broadly is sparse and it is not yet clear why this relationship exists. As a result, the research presented within the current thesis takes a theory-driven approach to obtaining a more nuanced understanding of association between sleep problems and future self-harm in young people. Chapter 2 aims to provide a rationale for the need to investigate symptoms of sleep disturbance as a risk factor for self-harm during adolescence. Chapter 2 will also detail the aims of the thesis, present the key research questions, and provide an outline of the remaining chapters.

Chapter 2 – Insights into adolescent sleep disturbance: An overview of causes, consequences, and the rationale for investigating sleep in relation to self-harm risk.

2.1 Chapter Overview

This thesis examines the role of adolescent sleep disturbance within self-harm pathways. Chapter 1 discussed the nature of self-harm, conveying that self-harm thoughts and behaviours result from the dynamic interplay between biological, social, psychological, and environmental factors. Current theoretical frameworks of self-harm account for this complexity, but are not exhaustive. As a result there is a need to identify modifiable risk factors which could be incorporated within models of self-harm, and present the opportunity to help young people who may be at risk of intentionally harming themselves. The work presented in this thesis investigates sleep disturbance within this context.

Adolescence is characterised by significant changes in sleep-wake patterns, such that young people are inclined to stay up later at night and prefer to rise later in the morning (Crowley, Acebo, & Jenni, 2007). As a result of these changes adolescents worldwide struggle to obtain enough sleep to function properly (Gradisar, Gardner, & Dohnt, 2011), and are more vulnerable to other symptoms of sleep disturbance such as insomnia (Dohnt, Gradisar, & Short, 2012). This is problematic as sleep plays a crucial role in adolescent development (Shochat et al., 2014), and disruption can negatively affect physical health, mental wellbeing and daily functioning (Kyle & Henry, 2017).

This chapter clarifies the rationale for investigating the relationship between sleep disturbances and self-harm during adolescence. The extant literature

concerning sleep and self-harm (irrespective of intent) is then briefly discussed and the limitations of the existing evidence base are highlighted. Here, a particular focus is placed on issues concerning the measurement of sleep disturbance. With the intention of demonstrating the multidimensional nature of adolescent sleep health, changes in sleep patterns that begin around puberty are described, and an overview of symptoms of sleep disturbance that are common during adolescence is provided. The chapter concludes by presenting the overarching aims and specific research questions that are addressed in this thesis.

2.2. What is the rationale for investigating the relationship between sleep disturbances and self-harm (irrespective of motivation) during adolescence?

Converging research evidence has identified sleep disturbance as an evidence-based risk factor for suicide and self-harm within the adult population (Bernert et al., 2015; Littlewood et al., 2017; Pigeon et al., 2012; Russell et al., 2019). Whilst these findings are important, there are several reasons why these results cannot be generalised to young people. Adolescence represents a distinct developmental period within the human lifespan and comprises various age-specific transitions across various developmental domains (WHO, 2014). Aside from infancy, adolescence is the second-most dynamic period of development for sleep (Gradisar & Tilton-Weaver, 2018). Young people differ from adults in terms of the timing of their weekday and weekend sleep patterns, require more sleep than adults to function optimally, and are particularly vulnerable to symptoms of sleep disturbance (Carskadon, 2011). These developmentally specific changes in sleep, and associated sleep problems, are discussed further in section 2.4.

Adolescence also represents a unique period in terms of brain development, with significant changes in brain structure and function occurring during this period (Chein, Albert, O'Brien, Uckert, & Steinberg, 2011; Mills, Christian, & Tamnes, 2016). As a result, adolescents differ from adults in terms of brain maturation, in such a way that the regions that promote risk-taking behaviour develop earlier than the regions that are central to decision-making and inhibition of sensation-seeking (Steinberg, 2010). This is of relevance to the rationale for the current thesis as individuals who engage in self-harm report higher levels of sensation seeking and elevated impulsivity than those who have never harmed themselves (Mars et al, 2014; Lockwood, Daley, Townsend, & Sayal, 2017).

Finally, adolescence represents a high-risk period for the onset of self-harm with evidence suggesting that for the majority of people self-harm will cease by late adolescence or early adulthood (Moran et al, 2012). Therefore, expanding our understanding of the potential relationship between sleep disturbance and self-harm during this particularly vulnerable period may provide insights that have the potential to make a valuable contribution to the development of early intervention strategies. Taken together, these findings suggest that research examining the relationship between sleep and self-harm, specifically in adolescents, is important.

There are several reasons why we would expect sleep disturbances to be associated with the onset and maintenance of self-harm in young people. During adolescence, poor sleep contributes to increased vulnerability across a broad range of emotional and mental health outcomes (Shochat et al., 2014). As a result, sleep disturbance has been proposed as a transdiagnostic process which contributes to heightened risk of negative outcomes across several domains of psychological health (Harvey, Murray, Chandler, & Soehner, 2011; Harvey, Hein, Dong, Smith,

Lisman, Yu et al., 2016). Within this transdiagnostic framework, it can be hypothesised that sleep disturbance may play a role in the onset and persistence of self-harm. Evidence to support this line of thinking comes from the fact that adequate sleep health during adolescence is integral to cognitive functioning and the regulation of mood and emotion (Baum, Field, Miller, Rausch, & Beebe 2014; Tarokh, Saletin, & Carskadon, 2016), both of which are compromised in young people who engage in self-harm (Andover & Morris, 2014; Fikke, Melinder, & Landrø, 2011). Deficits in emotion regulation are particularly relevant within this context, given that self-harm is commonly conceptualised as an emotion regulation strategy (Klonsky, 2007; Nock et al, 2009b). As such, it could be that young people see self-harm as one solution to difficulties in the regulation of emotion, which are triggered by poor sleep.

Adolescent sleep is also important in terms of regulating behaviour. Contemporary theoretical frameworks (e.g., IMV; O'Connor, 2011; O'Connor & Kirtley, 2018) conceptualise self-harm as a health behaviour. As such, it is possible that the aforementioned developmental mismatch between the affective and cognitive control brain systems will partly account for the increase in self-harm evident during adolescence. Notably, the prefrontal cortex, which is responsible for impulse control, is particularly sensitive to sleep disturbance. As such, it could be hypothesised that young people who experience poor sleep may find the relief associated with self-harm more rewarding and may find it harder to control the urge to engage in this behaviour, compared to an adolescent who is well rested. Therefore, sleep disturbance may represent a transdiagnostic process that bridges a number of emotional and behavioural difficulties during adolescence, including self-harm.

There is a pressing need to identify modifiable risk factors for the development and persistence of self-harm. Meta-analytic data relating to adolescent cognitive-behavioural sleep interventions provide preliminary evidence to suggest that these treatments are associated with a reduction in sleep disturbance (Blake, Sheeber, Yousef, Raniti, & Allen, 2017). In addition, these cognitive-behavioural techniques were also associated with improvements in comorbid symptoms of depression and anxiety (Blake et al., 2017). These findings demonstrate that: 1) adolescent sleep disturbance is amenable to change, and 2) improved sleep is associated with a reduction in psychological distress. Whilst self-harm outcomes were not examined in this meta-analysis, the findings suggest that interventions implementing cognitive-behaviour principles may provide the opportunity to explore whether improving sleep leads to a reduction in self-harm risk. Notably, research suggests that people may be more likely to seek help for sleep problems than for symptoms of mental illness, as the latter symptoms may be perceived to carry greater stigma (Bernert, Iwata, Kim, Moscowitz, & Hom, 2015). Given that mental health stigma has been identified as a barrier to young people seeking help (Kaushik, Kostaki, & Kiriakopoulos, 2016) it is possible that adolescents will also be more likely to disclose sleep problems compared to symptoms of mental health issues. Collectively, these findings provide a clear rationale for conducting research that focuses on examining the relationship between sleep disturbances and self-harm in young people.

2.3. Research examining the link between sleep disturbance and self-harm during adolescence

2.3.1. What do we know so far?

The association between sleep disturbances and self-harm has been examined in both clinical and community samples of young people (e.g., Blank,

Zhang, Lamers, Taylor, & Hickie, 2013; Hysing et al., 2015; Kaplan, Ali, Simpson, Britt, & McCall, 2014; McLinchey, Courtney-Seidler, German, & Millar, 2017). The extant literature is extensively reviewed in Chapter 3. Consequently, only a brief overview is provided within this chapter. To date, the vast majority of work has focused on sleep disturbance in relation to self-harm that is specifically associated with suicidal intent (i.e., thoughts and behaviours that are underpinned by a wish to die). In the past five years, however, a small body of research has begun to examine sleep problems in relation to non-suicidal self-injury and five investigations have employed a broader conceptualisation of self-harm (regardless of the underlying motivation or intent).

Taken together, these findings provide preliminary evidence to suggest that sleep problems during adolescence are associated with elevated risk of suicidal thoughts, suicide attempts, non-suicidal self-injury, and self-harm (irrespective of motivation and intent) (e.g., Bandel & Brausch, 2020; Fitzgerald, Messisa, & Buysse, 2011; Hysing et al., 2015; Kaplan et al., 2014; Wong, Brower & Craun, 2016). However, despite increased activity within this field of research, methodological challenges continue to limit the validity and generalisability of these findings. Moving forward, to ensure progress in our understanding of sleep disturbance within self-harming pathways, researchers in the field need to resolve these issues.

2.3.2. What are the ongoing issues within this field of research?

Research, which has sought to better understand the sleep-to-self-harm link during adolescence, has provided important preliminary insights. However, findings should be interpreted with caution due to on-going measurement issues within this

field of research. The following three concerns should be taken into consideration when designing future investigations.

2.3.2.1. The need to move beyond cross-sectional research

Several reviews of research examining the relationship between sleep, suicide and self-harm (Bernert et al., 2015; Littlewood et al., 2017; Russell et al., 2019) highlight that there is an over-reliance on cross-sectional research designs. This is especially true for work that focuses on the adolescent population, as only five studies have investigated the link prospectively (Liu et al., 2019; Lundh, Bjärehed, & Wångby-Lundh, 2013; Strandheim et al., 2014; Wong et al., 2011; Wong & Brower, 2012), and only one of these considered self-harm more broadly (i.e., irrespective of intent) (Wong et al., 2011). Whilst cross-sectional research designs do provide the opportunity to examine correlates of self-harm, longitudinal research is necessary to establish temporal precedence and to determine whether symptoms of sleep disturbance can aid in the prediction of *future* self-harm thoughts and behaviours. Further, sleep disturbance and self-harm (Kokkevi et al., 2012) are dynamic phenomena and fluctuate over time. As such, research that employs methodologies, which account for this variability (e.g., micro-longitudinal designs), is necessary.

2.3.2.2. The need for consistent operationalisations and assessment of sleep

Sleep disturbance can be assessed using both objective and subjective measures. Research investigating the relationship between sleep problems and self-harm in young people has relied exclusively on subjective assessment of sleep patterns and problems (i.e., questionnaires or single items within broader health surveys). This is justified as these measures are inexpensive, accessible, and can be implemented with ease as part of large-scale investigations. Whilst these tools

offer numerous advantages, inconsistent operationalisation and measurement of sleep disturbance is a challenge that is common within the wider field of sleep research and is particularly evident when examining the insomnia literature.

Issues with, and heterogeneity across, measurement of sleep disturbances are often overlooked, but can hinder interpretation of findings and undermine the conclusions that can be made. For instance, there is substantial variation in the operationalisation and measurement of insomnia across investigations that examine the relationship between this sleep complaint and self-harm in young people. Given that prevalence rates of insomnia can vary extensively according to different definitions and assessment criteria, this heterogeneity is problematic as it can lead to an inaccurate representation of the strength of the link between insomnia and self-harm risk. Insomnia is a sleep disorder that comprises both sleep-specific symptoms and symptoms of sleep-related daytime impairment. Despite this, almost all investigations have classified young people as having insomnia based on night-time symptoms alone.

Further, most studies employed single item and non-validated measures of insomnia, which fail to account for the duration, frequency and severity of symptoms. This information is necessary for an accurate diagnosis of insomnia. As such, it is important to interpret existing findings within the limits of what the measures employed can, and cannot, tell us. For example, when sleep-specific symptoms are assessed in isolation, we can say that difficulties initiating sleep or maintaining sleep confer increased risk for health outcomes. However, we cannot generate precise conclusions regarding insomnia per se. Without consistency and standardisation in definitions, operationalisation, and measurement, it is difficult to build a cumulative evidence base (Flake & Fried, 2019), and to meaningfully compare results between

investigations. As such, future research should employ standardised and validated measures of symptoms of sleep disturbances such as insomnia.

2.3.2.3. The need to embrace the complexity of adolescent sleep patterns and problems

Sleep health is a multidimensional construct, which encompasses a range of sleep domains. Different sleep characteristics do not occur in isolation and symptoms of sleep disturbance can be identified across a range of domains. For example, young people exhibit difficulties in terms of sleep continuity, sleep duration, sleep quality, sleep timing, and are particularly vulnerable to insomnia and nightmares (further details are provided in Section 2.4 below). Investigations that take a holistic view of adolescent sleep disturbance are necessary given that evidence reveals all characteristics of sleep disturbance are linked to health outcomes and that relationships are not necessarily uniform across different sleep domains (Buysse, 2014).

With few exceptions, research investigating the relationship between symptoms of sleep disturbance and self-harm, during adolescence, has failed to capture the breadth and multidimensional nature of sleep problems in young people. Most studies have examined one symptom of sleep disturbance in isolation, or at best a narrow range of sleep parameters. As such, it is not yet clear which specific aspects of sleep disturbance confer increased risk for self-harm thoughts and behaviour. Research that includes a detailed assessment of sleep, and takes into account a range of sleep parameters and problems simultaneously within multivariate statistical models, are necessary if we are to delineate which aspects of sleep are most important in predicting self-harm.

2.3.2.4 Next steps

In considering these on-going challenges, it is clear that researchers need to address issues in measurement that are currently hindering progress within this field. As such, future research should incorporate comprehensive assessments of sleep, use standardised and validated measures where available, and employ prospective research designs. Investigations of this nature have the potential to uncover which aspects of sleep disturbance are most relevant to the prediction and prevention of self-harm thoughts and behaviour. The following section will provide further details of the complex nature of sleep disturbance during adolescence, with the aim of reinforcing the need for research that takes a multidimensional approach.

2.4 Adolescent sleep as a multidimensional construct

As highlighted in section 2.3, sleep disturbance is a broad term, which is used to describe a range of sleep difficulties that a person may experience. Sleep disturbance initially emerges in the form of symptoms (such as not getting enough sleep, trouble falling asleep, or sleeping at a time that is significantly earlier or later than traditional sleep-wake schedules). Depending on the severity and persistence of these symptoms, as well as their impact on daytime functioning, they can sometimes lead to the development of a sleep disorder. Sleep disturbance is a multidimensional construct, which can be measured across a number of different domains including sleep duration, sleep continuity, sleep timing, and sleep quantity (Buysse, 2014). Individuals can exhibit disturbance on more than one of these aspects of sleep at the same time (Blunden & Galland, 2014). Changes in sleep-wake patterns are a hallmark feature of adolescence and many young people tend to

experience difficulties across each dimension of sleep disturbance (Crowley, Tarokh & Carskadon, 2014).

2.4.1. Symptoms of sleep disturbance in young people

Sleep continuity. Sleep continuity refers to how consistent a person's sleep is throughout the night and the ease with which they can fall asleep, remain asleep during the night, and refrain from waking up much earlier than planned (i.e., early morning awakening) (Tubbs, Dollish, Fernandez, & Grandner, 2019). Disturbances of sleep continuity are characterised by increased sleep onset latency (SOL; the amount of time it takes to fall asleep), increased wake after sleep onset (WASO; duration of wakefulness during the night), and decreased sleep efficiency (SE; percentage of time in bed that a person spends asleep). Research evidence suggests that young people commonly experience difficulties falling asleep, particularly on school nights, and that 15%-59% of adolescents report sleep onset latencies of 30 minutes or more (Gradisar et al., 2011; Hysing, Pallesen, Stormark, Lundervold, & Sivertsen, 2013; Short, Gradisar, Gill, & Camfferman, 2013a; Short, Gradisar, Lack, Wright, & Dohnt, 2013b). Taking longer than 30 minutes to fall asleep is one clinical indicator for an elevated risk of sleep disorders in this population (i.e., sleep onset insomnia or delayed sleep phase disorder: Buysse, Ancoli-Isreal, Edinger, Lichstein, & Morin, 2006; Lovato, Gradisar, Short, Dohnt, & Micic, 2013). These sleep disorders will be discussed in detail in subsection 2.4.2. Around 5% of young people have difficulty maintaining sleep and report experiencing wakefulness during the night that lasts longer than 30 minutes (Short et al., 2013b). Young people who demonstrate difficulties initiating and/or maintaining sleep will be

awake for a significant proportion of their time spent in bed and, as a result, will experience poorer sleep efficiency.

Sleep duration. Sleep duration, also known as total sleep time (TST), concerns the total amount of sleep obtained within a 24-hour period. Experts from the American Academy of Sleep Medicine and the National Sleep Foundation suggest that youths should optimally obtain between 8 and 10 hours of sleep per night (Hirshkowitz et al., 2015; Paruthi et al., 2016). This recommendation is supported by recent evidence confirming that adolescents require around 9 hours of sleep for optimal daily functioning (Fuligni, Arruda, Krull & Gonzales, 2019; Short, Weber, Reynolds, Coussens, & Carskadon, 2018). However, one review and meta-analysis (examining the sleep patterns of 367,328 adolescents worldwide) demonstrated that young people often fail to achieve eight hours of sleep on school nights (Gradisar et al., 2011). Results from the most recent "Sleep in America" poll, reveal that around 1 in 6 young people obtain less than 8 hours sleep on school nights and another investigation, which pooled objective sleep data, demonstrated that young people aged 12-18 typically sleep for around 7 hours on average (Galland et al., 2018). This discrepancy between the recommended sleep duration and actual total sleep time in young people results in a substantial sleep debt of almost two hours per day (Calamaro, Mason, & Ratcliffe, 2009; Hysing et al., 2013). Consequently, adolescents experience chronic sleep deprivation and daytime sleepiness increases dramatically during this developmental period (Crowley et al., 2014a; Gradisar et al., 2011).

Sleep timing. Sleep timing refers to the placement of sleep within the 24-hour day and whether an individual is sleeping at the right time of day or not. This is an oft-overlooked dimension of sleep disturbance (Kyle & Henry, 2017) but is

particularly relevant during adolescence (Fischer, Lombardi, Marucci-Wellman, & Roenneberg, 2017). Within the general population, there is large variability across individuals in terms of sleep timing (Roenneberg et al., 2007). An individual's preference for the timing of their sleep and wakefulness is referred to as their chronotype (i.e., the extent to which someone is a morning or evening person) (Roenneberg, Wirz-Justice, & Merrow, 2003). Following the onset of puberty, young people demonstrate a shift towards an evening chronotype and indicate an increased preference for going to bed later and waking up later than either children or adults (Gradisar et al., 2011). Adolescents' preferred time for bedtime and sleep onset gets progressively later and a peak in lateness occurs at approximately 19 years old (Roenneberg, 2004). Following their teenage years, individuals tend to demonstrate an increased preference for earlier bedtimes and wake up times than when they were an adolescent (Fischer et al., 2017). These changes in sleep timing during adolescence are problematic because young people struggle to fall asleep until later at night but are required to rise at a socially conventional time to honour social commitments (e.g., going to school). As a result, opportunity for sleep is truncated and young people have trouble obtaining enough sleep (Carskadon, 2011; Crowley et al., 2014).

Sleep timing regularity. The regularity of sleep timing (i.e., the extent to which an individual goes to sleep and wakes up at about the same time each day) is also of particular importance during adolescence (Owens, 2014). Discrepancies in the timing of school night and weekend sleep are common in this population (Gradisar et al., 2011). As discussed, many young people accumulate a significant sleep debt throughout the week, as they are unable to obtain sufficient sleep on school nights (Hysing et al., 2013). To compensate for this, young people often

extend the time that they spend asleep on weekends by waking up later in the day (Gradisar et al., 2011). As a result, young people worldwide will obtain upward of two hours more sleep at the weekend relative to school nights (Andrade et al, 1993; Gau & Soong, 2003; Giannotti et al, 2002; Loessl et al, 2008; Reid et al, 2002; Saarenpaa-Heikkila et al, 1995; Urner et al, 2009; Wolfson & Carskadon, 1998). Although this change in sleep-wake schedule does provide a temporary solution to the accrued sleep debt, this irregularity in sleep timing between weekdays and weekends is problematic as it leads to disruption in adolescents' sleep-wake schedules that is akin to jet lag. Irregular sleep patterns are more prevalent among 10-17 year olds than any other age group (Borisenkov et al., 2017)

Notably, evidence from the jet lag literature demonstrates that humans quickly and easily adapt to later bedtimes and wake up times (such as those exhibited by adolescents on weekends), but struggle to adjust to earlier sleep schedules (Waterhouse, Reilly, Atkinson & Edwards, 2007). Abrupt shifts in the timing of sleep from later bedtimes and rise times at weekends, to being woken up for school at a time that is often at least 3-4 hours earlier than their body expects to be awake (Wolfson & Carskadon, 2003), leads to a phenomenon called "social jet lag" (SJL). This has been likened to travelling across time zones between school days and weekends, and results in a discrepancy between the adolescent's internal schedule (i.e., biological time) and the time zone of the outside world (i.e., social time) (Roenneberg et al., 2003; Wittman, Dinich, Merrow, & Roenneberg, 2006). Whilst the experience of jet lag is transient for most people, youths are chronically exposed to sudden shifts in their sleep-wake schedules and experience jet lag like symptoms of extreme tiredness, difficulty falling asleep on school nights, and trouble waking up in the morning (Touitou, 2013).

Sleep quality. Sleep quality (SQ) concerns adolescents' subjective satisfaction with their sleep, and is operationalised as an individual's global appraisal of their experience of disturbed sleep (Buysse, 2014). Investigations often classify young people as good sleepers or poor sleepers (De la Vega et al., 2015) based on global ratings of sleep quality. Research suggests that an individual's subjective satisfaction with their sleep appears to be determined by not only what happened during the sleep period, but also how they feel immediately after sleep and during the following day (Ohayan et al., 2018; Ramlee, Sanborn, & Tang, 2017). A significant proportion of young people report being dissatisfied with their own sleep and perceive it to be poor (Im, Oak Oh, & Suk, 2017; Kim, Kim, & Kim, 2016), and over half of young people report waking feeling unrefreshed at least a few times a week (Gradisar et al., 2013).

Nightmares. Another common symptom of sleep disturbance is nightmares (Nielsen & Levin, 2008). These are emotionally distressing and/or frightening dreams that cause the individual to awaken (Levin & Nielsen, 2007) and often feature a range of emotions including fear, terror, panic, disgust, grief and humiliation. Prevalence estimates of nightmares within the adolescent population vary widely (6.4% to 41%; Coolidge, Segal, Coolidge, Spinath, & Gottschling, 2010; Wong, Brower, & Zucker, 2011) and comparisons between studies are complicated by variation in operationalisation and measurement. This symptom of sleep disturbance is particularly common in young people with mental health problems, whereby there are marked differences in the prevalence rates of clinically salient nightmares in clinical and community samples of young people (46% vs. 20%; Arora, Broglia, Thomas, & Taheri, 2014; Kaplan et al., 2014; Russell, Rasmussen, & Hunter, 2018). When a young person experiences nightmares that are frequent and distressing

enough to be associated with clinically significant distress or impairment in daily functioning, as well as an inability to maintain a regular sleep-wake cycle, they meet the diagnostic criteria for Nightmare Disorder (APA, 2013). Despite the prevalence of nightmares in the adolescent population, it is not yet clear from the literature how many young people meet the clinical threshold for this disorder.

Collectively, research highlights that sleep disturbance is multidimensional, and young people experience difficulties across several different aspects and sleep parameters. These are summarised in Table 2.1.

Table 2. 1. Dimensions and symptoms of sleep disturbance that are relevant during adolescence (adapted from Buysse, 2014)

Sleep dimension	Definition of sleep dimension	Relevant sleep parameters
Sleep continuity	The ease of initiating and maintaining sleep. *Is the individual able to fall asleep with ease, remain asleep during the night and not experience early morning awakening?*	• Sleep onset latency • Wake after sleep onset • Sleep efficiency
Sleep duration	The total amount of sleep occurring within a 24-hour day. *Is the individual getting enough sleep?*	• School night total sleep time • Weekend total sleep time
Sleep timing	The temporal occurrence of sleep within a 24-hour day. *Is the individual sleeping at the right time of day? Does the individual go to sleep and wake up about the same time each day?*	• Chronotype • Social jet lag
Sleep quality	Subjective appraisal of good or poor quality sleep. *Does the individual feel that they slept well? Are they satisfied with their sleep?*	• Subjective sleep quality
Nightmares	Emotionally distressing and/or frightening dreams that cause the individual to awaken. *Does the individual experience nightmares?*	• Frequency and severity of nightmares

2.4.2 Symptoms of sleep disorders in young people

According to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V; APA, 2013) sleep problems can be categorised into 10 disorder groups. To meet the clinical threshold and warrant a diagnosis of a sleep disorder, disturbed sleep must be associated with distress and significant impairment in daytime functioning (APA, 2013). The most commonly reported sleep disorders within the adolescent population are Insomnia Disorder (de Zambiotti, Goldstone, Colrain, & Baker, 2018) and Delayed Sleep Phase Disorder (Gradisar & Crowley, 2013).

2.4.2.1. Insomnia Disorder

Insomnia is predominantly regarded as a disorder of sleep duration and quality, and is characterised by the presence of difficulties initiating sleep, maintaining sleep throughout the night, early morning awakening, or by chronically unrefreshing sleep (American Academy of Sleep Medicine [AASM], 2014; APA, 2013). To reach the clinical threshold for disorder status, an individual should be experiencing these sleep difficulties at least three times a week, and symptoms should have been present for three months or longer (Hysing et al., 2013). Importantly, given that insomnia is recognised as a 24-hour disorder, a diagnosis is made only when night-time symptoms of sleep disturbance are associated with impaired daytime functioning (Morin et al., 2015). Specific functional complaints relevant to a diagnosis of Insomnia Disorder include effects on mood, energy, productivity and relationships (Espie et al., 2014). Insomnia complaints can be assigned to one of four specific subtypes (see Table 2.2).

Table 2. 2. Specific subtypes of Insomnia Disorder

Subtype of insomnia	Definition of subtype
Sleep-onset	Individuals report difficulties initiating the sleep process and will report a sleep onset latency of ≥ than 30 minutes.
Maintenance	Individuals report difficulties maintaining sleep throughout the night and are forced to attempt to fall back asleep. This can take the form of repeated unsuccessful attempts to re-initiate the sleep process and will involve awakenings of ≥ than 30 minutes.
Early morning	Individuals report disruption of sleep by waking earlier than desired and being unable to fall back to sleep.
Mixed	Individuals may report experiencing a combination of any of the insomnia complaints (i.e., sleep-onset, maintenance and/or early morning.

Insomnia is the most prevalent sleep disorder amongst adolescents, with difficulties initiating sleep (sleep-onset insomnia) being the most predominant complaint (Gradisar et al., 2011; Hysing et al., 2013; de Zambiotti et al., 2018). Several epidemiological studies have been conducted internationally to assess insomnia symptom and disorder prevalence rates (Johnson, 2006; Ohayon, Roberts, Zully, Smirne, & Priest, 2000, Dohnt et al., 2012). However, as noted in Section 2.3, prevalence rates in young people range widely (2%-39%) as a result of the different definitions and methodologies employed across studies (de Zambotti et al., 2018). Hysing and colleagues (2013) conducted the first and, to our knowledge, only investigation of adolescent insomnia prevalence using DSM-V criteria. In a large

sample (n=10,220) of Norwegian adolescents, aged 16-18 years old, 18.5% met the criteria for a diagnosis of insomnia disorder. Collectively, evidence suggests that within the adolescent population, insomnia is prevalent and is likely to persist over time (Roberts, Roberts, & Duong, 2008; Luo, Zhang, & Pan, 2013).

2.4.2.2. Delayed Sleep Phase Disorder

As discussed in subsection 2.4.1, adolescent sleep patterns are characterised by later bedtimes and rise times (particularly on weekends). As a result, sleep opportunity is restricted and many young people do not obtain sufficient sleep (Crowley et al., 2014a). For some young people, sleep-wake schedules are located at the extreme end of the continuum of normal adolescent delayed sleep, such that their preferred bedtimes and wake-up times are comparatively significantly later than their adolescent peers (Gradisar et al., 2011). These sleep patterns, and the symptoms of sleep disturbance associated with them, are characteristic of Delayed Sleep Phase Disorder (DSPD). According the DSM-5, DSPD is a circadian rhythm sleep disorder where the individuals sleep pattern is significantly delayed in timing (i.e., sleep onset occurs around 2am-6am), which results in a chronic inability to fall asleep and wake up at socially acceptable times, even if the person has the opportunity to sleep earlier (APA, 2013; Lovato et al., 2013). That is to say, there is a misalignment between a person's biologically driven sleep-wake schedule and the externally imposed sleep-wake pattern required by traditional school or work schedules. This problem should be present for at least 3 months to warrant a diagnosis of DSPD (APA, 2013).

Whilst over half of adolescents report at least one symptom of DSPD (Lovato et al., 2013), this pattern of sleep is only considered to be disordered when it causes

distress and/or is associated with significant daytime impairments (APA, 2013). These may include significant difficulty rising for school in the morning, school non-attendance, daytime sleepiness, chronic sleep reduction, and poor school performance (Gradisar & Crowley, 2013). DSPD predominantly affects adolescents and young adults, and prevalence rates for young people range from 1% to 16%, depending on the operationalisation of the disorder that has been employed (Lovato et al., 2013; Gradisar & Crowley, 2013). When adolescents with DSPD are given the opportunity to set their own schedules, for example during the school holidays, no symptoms of sleep disturbance are expressed, sufficient and restorative sleep is obtained, and no impairment in daytime functioning is experienced (Hysing et al., 2013). Whilst DSPD does limit the opportunity for sleep, it is specifically a disorder of sleep timing, whilst insomnia is a disorder of sleep quality or quantity (Crowley et al., 2014a). Nonetheless, the overlap between insomnia and DSPD is high (Siversten, Pallesen, Stormark, Boe, Lundervold, & Hysing, 2013). A discrepancy of more than two hours between weekday and weekend bedtimes is indicative of DSPD (Short et al., 2013b). Table 2.3 summarises the defining characteristics of Insomnia Disorder and Delayed Sleep Phase Disorder, as well as prevalence estimates within the adolescent population. DSM-V estimates were taken from two investigations that sought to establish the prevalence of these sleep disorders using the most up to date diagnostic criteria. To our knowledge, only Hysing et al (2013) and Sivertsen et al (2013) have utilised DSM-V criteria. The range of prevalence estimates were then established by examining the most recent reviews of literature focusing on these sleep disorders in adolescents (Gradisar & Crowley, 2013; deZambotti et al, 2013).

Table 2. 3. Defining characteristics and estimated prevalence rates of insomnia disorder and delayed sleep phase disorder in adolescents

Sleep disorder	Defining characteristics of disorder (DSM-V)	Estimated Prevalence
Insomnia Disorder	Predominantly a complaint of dissatisfaction with sleep quantity of quality characterised by one or more of the following symptoms: 1. Difficulty initiating sleep 2. Difficulty maintaining sleep characterised by frequent awakenings and problems returning to sleep 3. Early morning awakening with an inability to re-initiate sleep Sleep disturbance associated with clinically significant distress and/or daytime impairment.	DSM-V: 18.5% (Hysing et al., 2013) Range: 4%-39% (deZambotti et al., 2018)
Delayed Sleep Phase Disorder	Predominantly a complaint of dissatisfaction with sleep timing characterised by: 1. A persistent pattern of delayed sleep-wake times and a chronic inability to fall asleep and awaken at a desired earlier time. 2. Misalignment between internally driven sleep wake preferences and externally imposed schedules. 3. Adequate and refreshing sleep when people can choose their own schedule. Sleep disturbance associated with clinically significant distress and/or daytime impairment.	DSM-V: 3.3% (Sivertsen et al., 2013) Range: 1%-16% (Gradisar & Crowley., 2013)

2.5. Why are adolescents at increased risk of symptoms of sleep disturbance and disorders?

As discussed in section 2.4, adolescents are particularly vulnerable to symptoms of sleep disturbance. Given that this represents a significant public health issue, it is important to understand what factors can influence adolescent sleep. Research evidence suggests that many internal and external factors can be detrimental to sleep health in this population (Carskadon, 2011; Crowley, Acebo, & Carskadon, 2007; Owens, 2014; Tarokh & Carskadon, 2010). The Perfect Storm model of adolescent sleep was developed to illustrate how young people's sleep is influenced from a biological, psychological, and social standpoint (Carskadon, 2011; Crowley & Carskadon, 2018). Figure 2.1 below provides a visual representation of how the maturation of biological sleep regulatory systems interact with psychological and societal pressures, over the course of adolescent development, to result in sleep disturbance (Crowley & Carskadon, 2018).
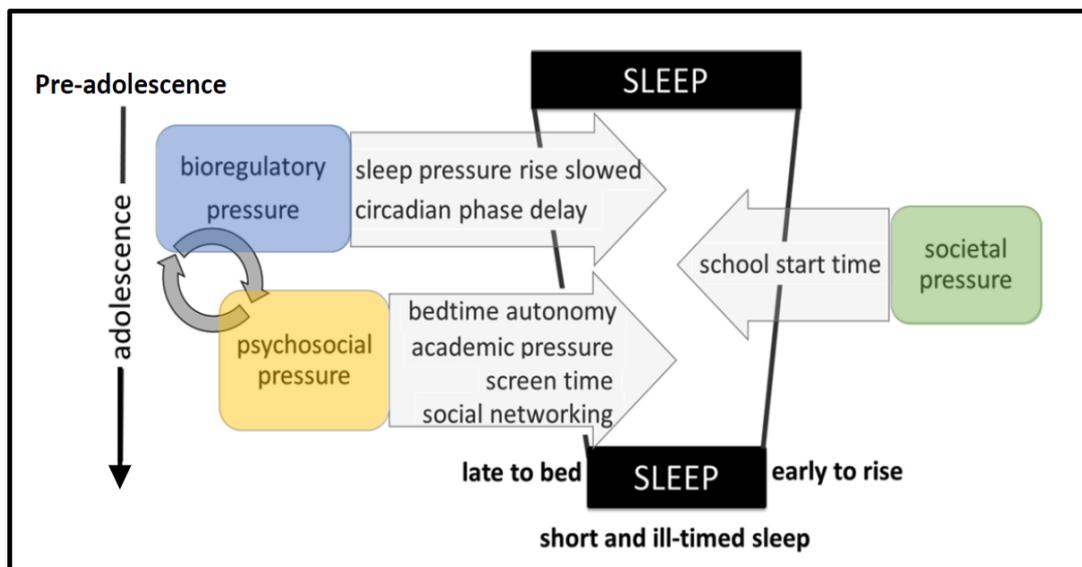
Figure 2. 1. A visual representation of the "Perfect Storm" model of adolescent sleep (Crowley & Carskadon, 2018)

2.5.1. Bioregulatory pressures

A major driver of young people's preference for later bedtimes (and wake up times) is the delay in their circadian rhythm timing that is triggered early in puberty (Borisenkov, 2011; Carskadon, 2011; Roenneberg & Merrow, 2007). Circadian rhythms (such as that of sleep and wake) follow a predictable 24-hour cycle and are regulated by a biological clock located in the suprachiasmatic nuclei of the hypothalamus (Moore & Eichler, 1972). During early adolescence, a neurobiological change in most young people's biological clock results in a two to three hour delay in the release of the sleep-promoting hormone melatonin (Carskadon, Vieira, & Acebo, 1993; Carskadon, Acebo, & Jenni, 2004). As a result, adolescents are biologically programmed to exhibit a later chronotype (i.e., their preference for the timing of sleep and wakefulness is delayed) and they will become increasingly inclined to stay up, and sleep in, later (Roenneberg et al., 2003). After this shift in circadian rhythms, young people will struggle to fall asleep prior to 11pm and wake up before 8am, even if they attempt to go to bed earlier (Berger, Widome, & Troxel, 2018).

Developmentally driven alterations in circadian rhythms coincide with changes in the homeostatic sleep-wake process (i.e., sleep pressure or drive for sleep), making it all the more challenging to achieve sufficient sleep during the week (Carskadon, 2011). An individual's homeostatic sleep drive is akin to an hourglass, the longer they are awake, the greater the sleep pressure, and increased propensity to sleep (Borbely, Achermann, Trachsel, & Tobler, 1989). Furthermore, the longer they are asleep, sleep pressure lessens and the likelihood of waking increases (Borbely et al., 1989). At the onset of puberty, the drive to sleep builds more slowly, relative to childhood, meaning that adolescents do not feel tired until later in the evening, and are able to maintain wakefulness for longer (Jenni, Achermann, &

Carskadon, 2005). Notably, the rate at which the pressure to sleep dissipates during the night remains stable throughout this developmental period (Tarohk, Carskadon, & Achermann, 2012). This implies that despite young people not feeling tired until later in the evening, the amount of sleep they need to function optimally (i.e., their sleep need) remains stable throughout adolescence.

Understanding developmental changes in circadian and homeostatic sleep processes is important in grasping why young people have a tendency to go to bed later and sleep in. Further, these biological pressures partially explain why adolescents are more vulnerable to sleep disturbance. However, meta-analytic data has demonstrated that, for most young people, the trend towards decreased sleep duration only applies to school nights (Ohayan, Carskadon, Guilleminault, & Vitiello, 2004). Given that adolescents largely obtain sufficient sleep on weekend nights, when they are free to determine their own schedules, this suggests that external pressures (i.e., psychosocial and societal) may also impinge on adolescents sleep opportunity.

2.5.2. Psychosocial pressures

During adolescence, young people are more autonomous, and parents are less likely to be involved in setting bedtimes and regulating sleep schedules (Short et al., 2011). Therefore, young people have more freedom to choose their own later bedtimes. Increasing academic pressures also compound the biological delay in young people's sleep wake timing (Owens, 2014). This is evidenced by research, which demonstrates that sleep duration is more restricted in countries where academic pressure is higher (i.e., Asia) (Carskadon, 2011; Gradisar et al., 2011; Olds, Blunden, Petkov, & Forchino, 2010). The Perfect Storm model also highlights

the effects of night-time use of technology (screen time) and social networking on young people's sleep-wake schedules (Carskadon, 2011). For example, engaging with technology (specifically video gaming, as well as internet, computer and phone use) is associated with later sleep onset (Bartel, Gradisar, & Williamson, 2015), which consequently constrains young people's sleep opportunity. Further, it has been suggested that social media may perpetuate a cycle of insufficient sleep in young people, by affording young people the opportunity to interact with their peers 24/7 (Vernon, Barber, & Modecki, 2015; Woods & Scott, 2016). Young people find it difficult to disengage from social media at bedtime and have identified this as a cause of their delayed sleep onset and daytime tiredness (Scott, Biello & Woods., 2018).

In a recent update of the Perfect Storm model, Crowley and Carskadon (2018) proposed that biopsychosocial and behavioural factors might converge to restrict adolescent opportunities for sleep. More specifically, it is suggested that the changes in circadian and homeostatic processes, which promote alertness later in the evening, may facilitate young people's engagement in other activities besides sleep. Equally, activities that promote cognitive, emotional or social stimulation (e.g., engaging in interactions on social media) may compound these biological drivers of delayed sleep onset, meaning that young people will not initiate sleep till even later (Crowley & Carskadon, 2018; Scott & Woods, 2018).

2.5.3. Societal pressures

Whilst bioregulatory and psychosocial pressures drive young people's tendency to go to bed later, rise times remain stable or become earlier throughout adolescence (Gradisar et al., 2011). As a result, it is only when societal pressures,

such as school start times, force adolescents to wake up early that total sleep time is impacted (Tubbs et al., 2019). That is to say, that delayed sleep onset will not necessarily result in restricted sleep duration, unless an early rise is enforced by social schedules. Early school start times are perhaps the most robust environmental constraint on adolescent sleep (American Academy of Pediatrics [AAP], 2014; Barnes et al., 2016). This is supported by research demonstrating that wake up times shift later when young people's sleep patterns are not dictated by school schedules (e.g., during school holidays or when adolescents transition out of high school) (Carskadon, Acebo, & Seifer, 2001; Crowley et al., 2014b).

2.6. What are the outcomes of sleep disturbance during adolescence?

Symptoms of sleep disturbance and sleep disorders are widespread during adolescence (Gradisar et al., 2010). This is concerning as sleep plays an important role in the maintenance and restoration of the body and brain (Buysse, 2014) and, as such, is a key determinant of health across the lifespan (Kyle & Henry, 2017; National Institute of Health, 2013). An extensive review of research examining the outcomes of adolescent sleep disturbance demonstrated that sleep is closely linked to physiological, psychosocial, cognitive, academic, and behavioural functioning (Shochat et al., 2014).

Given that academic performance during adolescence is an important predictor of attainment in subsequent education and work (Dowrick, Back, & Mills, 2015), a considerable amount of research has focused on the link between sleep and academic success (Dewald, Meijer, Oort, Kerkhof, & Bogels, 2010). Findings demonstrate that shorter sleep duration, poor sleep quality, and increased daytime sleepiness are related to poorer performance in school (Hysing, Harvey, Linton,

Askeland, & Sivertsen, 2016). Sleep disturbances are associated with deficits in cognitive functioning, and even short periods of sleep loss can impair young people's ability to pay attention in class, learn new information, and make decisions (Carskadon, 2011; Lo, Ong, Leong, Gooley, & Chee, 2016). As such, cognitive deficits may partly account for the relationship between sleep and academic achievement.

In terms of mental health, it is argued that sleep disturbances precipitate and maintain symptoms of psychological distress (Dahl & Harvey, 2007; Shochat et al., 2014). For example, meta-analytic data suggests that sleep disturbances are likely to be a precursor for the development of depressive symptoms, whilst depression at baseline does not necessarily predict later symptoms of poor sleep (Lovato & Gradisar, 2014). Likewise, evidence supports the proposition that disturbances in sleep may precede the development of anxiety in youth (McMakin & Alfano, 2015). Beyond psychiatric outcomes, experimental and longitudinal investigations have demonstrated that restricted sleep is associated with a poorer ability to regulate emotion and mood, and that young people who experience sleep problems reported less positive, and more negative, moods (Baum et al., 2014; Short & Louca, 2015; Talbot, McGlinchey, Dahl, & Harvey, 2010). As such, it is not surprising that poor sleep predicts lower subjective wellbeing (Kalak, Lemola, Brand, Holsboer-Trachsler, & Grob, 2014).

Regarding physical health, sleep disturbance is associated with a variety of negative outcomes including poorer immune function (Cohen, Doyle, Alper, Janicki-Deverts, & Turner, 2009; Bryant, Trinder, & Curtis, 2004), obesity (Koren & Taveras, 2018), diabetes (Shan et al., 2015), and fatigue (Owens, 2014). Further, adolescents with disturbed sleep report inferior perceived health and worse physical symptoms

such as headaches and gastrointestinal difficulties (Roberts, Roberts, & Duong, 2014). As well as influencing young people's physiological functioning, sleep is also linked to behavioural outcomes during adolescence (O'Brien & Mindell, 2005; Shochat et al., 2014). Sleep disturbances, particularly insufficient sleep duration, are associated with an increased tendency to participate in a diverse range of risky health behaviours including smoking, underage alcohol consumption, recreational drug use, unprotected sexual activity, and drowsy driving (McKnight-Eily et al., 2011; O'Brien, & Mindell, 2005; Pasch, Laska, Lytle, & Moe, 2010; Wittman, Paulus, & Roenneberg, 2010). However, one meta-analysis cautioned that few studies examining these relationships have employed longitudinal or experimental designs (Short & Weber, 2018). As a result, the directionality or causality of these relationships cannot be inferred from existing findings.

It is important to note that adolescence represents a high-risk period for the onset of risk-taking behaviours around the world (Gardner & Steinberg, 2005; Steinberg, 2006). Almost all risk-taking behaviours follow an ∩-shaped curve, increasing from preadolescence to mid adolescence and decreasing from adolescence to adulthood (Steinberg et al., 2018). It has been theorised that this peak during adolescence occurs as the result of a maturational imbalance in the developmental trajectories of the affective system (i.e., limbic system: which is sensitive to sensation/novelty seeking), and the cognitive control system (i.e., prefrontal cortex: which is responsible for self-regulation) (Steinberg, 2010; Somerville & Casey, 2010).

The earlier maturation of the affective system means that young people are particularly sensitive to the rewards associated with sensation seeking. On the other hand, as the prefrontal cortex is immature, adolescents are less likely to be able to

control the urge to engage in these behaviours, despite the risks associated with them (Strang, Chein, & Steinberg, 2013). This combination of heightened reward sensitivity and immature impulse control results in increased risk taking behaviour during mid-adolescence. This developmental mismatch in brain systems is amplified in young people experiencing sleep disturbance, as the prefrontal cortex is particularly sensitive to sleep loss (Yoo, Gujar, Hu, Jolesz, & Walker, 2007; Telzer, Fuligni, Lieberman, & Galvan, 2013).

Taken together, findings within this field of research consistently demonstrate that symptoms of sleep disturbance are associated with negative outcomes across a range of health and functioning domains. This burgeoning body of evidence suggests that sleep does play a crucial role in adolescent development. That said, there is a need for researchers within this field of inquiry to extend their research focus and examine other issues that are known to emerge during adolescence (Gradisar & Tilton-Weaver, 2018). Whilst research has begun to examine the relationship between sleep disturbance and self-harm in young people, investigations have not established the role of specific sleep parameters, and much less is known about the association in adolescents compared to the adult population (see section 2.3 for a brief overview). Given that both of these phenomena emerge during adolescence, and together represent public health issues worldwide, this may represent a critical developmental window for understanding the potential role of sleep disturbances in the onset and maintenance of self-harm. Consequently, the current thesis will focus specifically on advancing knowledge in this research area.

2.7. Aims to be assessed in this thesis

This chapter highlights that research has begun to investigate the relationship between sleep problems and self-harm during adolescence, but that this field of research is in its infancy. Progress within this area of research has been hindered by an overreliance on cross-sectional findings, inconsistency in the operationalisation and assessment of sleep problems, and a failure to account for the multidimensional nature of sleep disturbance during adolescence. Future research should aim to overcome these challenges. In response to this need, the current thesis has two overarching aims. The first aim is to provide a more detailed and nuanced understanding of the association between specific adolescent sleep disturbances and future self-harm. More specifically, where the current thesis refers to specific symptoms of sleep disturbance, these include disrupted sleep continuity, sleep duration, sleep timing, sleep quality, as well as symptoms of insomnia, and nightmares. The second aim of the current thesis is to establish a theory-based understanding of the psychological processes that underpin the relationship between sleep disturbance and self-harm risk in order to understand why this relationship may exist.

More specifically, the current thesis aims to answer the following research questions:

1. What does the existing literature tell us about the link between specific sleep complaints and self-harm in young people?
2. Do specific symptoms of sleep disturbance during adolescence predict future self-harm?

3. What role (if any) do psychological factors, derived from a prominent model of self-harm (i.e., IMV), have within this relationship?

4. Does sleep predict next-day self-harm thoughts and behaviour?

By investigating these questions, this PhD thesis explores the complex relationships between specific symptoms of sleep disturbance and self-harm, and some of the psychological processes driving this relationship in young people. In designing this research, this thesis sought to make a novel contribution to the literature that has the potential to inform policy and practice to support young people at risk of self-harm. These aims are addressed by a systematic review, a six-month prospective school-based investigation, and an intensive longitudinal diary study.

2.8. Structure of thesis

Chapter 3 aims to systematically review and critically appraise the extant literature on sleep and self-harm (with and without suicidal intent), and highlights the strengths and limitations of the available literature to date. The conclusions from conducting this review are used to inform the design and implementation of the studies conducted as part of this thesis (Chapters 4-6). Chapter 4 examines the prospective relationship between specific sleep complaints and self-harm within a community sample. Chapter 5 extends these findings by examining the relationship between relevant symptoms of sleep disturbance and self-harm within the context of a theoretical model of self-harm (the IMV). Theoretically informed predictions were tested to enhance understanding of the psychological mechanisms underpinning the relationship between specific sleep complaints and self-harm in adolescence. Chapter 6 presents the results of an intensive longitudinal study that aims to characterise the short-term temporal aspects of the relationship between sleep and

self-harm (i.e., do specific aspects of sleep disturbance predict self-harm thoughts and behaviours the following day). Finally, Chapter 7 provides a general discussion of the empirical findings from this thesis, its limitations, potential directions for future research and possible implications in terms of measurement, theory, practice, and policy. The purpose of each study presented in this thesis is summarised in Table 2.4.

Table 2. 4. Purpose of the investigations presented in thesis

Chapter	Limitations in existing literature	Purpose of the study
Chapter 3 Examining the role of sleep disturbance in relation to suicide and self-harm risk during adolescence: A systematic review and research agenda.	• No previous reviews have synthesised the results from studies investigating the link between symptoms of sleep disturbance and self-harm (irrespective of motivation and intent) during adolescence.	• Evaluate the evidence base concerning the link between sleep and self-harm in young people. • Present a detailed research agenda that highlights priorities for future work.
Chapter 4 Do symptoms of sleep disturbance predict future self-harm behaviour in young people? A six-month prospective investigation	• The existing sleep-self-harm evidence base is limited by: 1) overreliance on cross-sectional research designs, 2) use of non-standardised measures of sleep and self-harm, and 3) a narrow focus in terms on sleep-related constructs.	• Establish the prevalence of sleep problems, self-harm thoughts and self-harm behaviours in Scotland. • Conduct a detailed assessment of the relationship between symptoms of sleep disturbance and subsequent self-harm risk during adolescence.
Chapter 5 Why are sleep problems associated with self-harm risk during adolescence? Investigating the role of defeat and entrapment	• There is a lack of research examining *why* symptoms of sleep disturbance confer increased risk of self-harm during adolescence.	• To examine the role of theoretically salient psychological factors in the relationship between symptoms of sleep disturbance and future self-harm thoughts.
Chapter 6 Examining the link between symptoms of sleep disturbance, self-harm risk and psychological factors in adolescents' daily lives: A micro-longitudinal investigation	• Understanding of the relationship between sleep problems and self-harm during adolescence is driven by cross-sectional research and a limited number of prospective studies that span months or years. The short-term (day-to-day) predictive utility of is not yet known.	• To determine whether symptoms of sleep disturbance, defeat and entrapment predict self-harm thoughts and behaviours the following day.

2.9. Key points from Chapter 2:

1. Research suggests that sleep disturbance is associated with suicidal ideation, suicide attempts, non-suicidal self-injury, and self-harm (irrespective of intent). However, methodological issues have limited the formation of clear conclusions.

2. Research that takes a multidimensional approach to assessing sleep is necessary, as sleep disturbance is a broad term, which describes a range of sleep difficulties that an individual may experience.

3. Changes in sleep-wake patterns are a hallmark feature of adolescence. Many young people experience issues across each domain of sleep disturbance, and adolescents are particularly vulnerable to sleep disorders, such as Insomnia Disorder and Delayed Sleep Phase Disorder.

4. The Perfect Storm model of adolescent sleep (Carskadon, 2011; Crowley & Carskadon, 2018) illustrates that changes in biological sleep regulatory systems interact with psychological and societal pressures, over the course of adolescent development, and render young people vulnerable to sleep disturbances.

5. The widespread nature of adolescent sleep disturbance is concerning as sleep is a determinant of health across the lifespan. Research evidence suggests that there may be a link between sleep problems and self-harm within the adolescent population.

6. The current thesis aims to 1) provide a more nuanced investigation of specific symptoms of sleep disturbance in relation to self-harm and 2) begin to establish an understanding of why poor sleep may be associated with self-harm in young people.

2.10. Next Steps

Chapter 3 systematically reviews, critically appraises and synthesises the literature investigating sleep disturbances and self-harm in adolescence. It presents a detailed research agenda, which will guide the investigations, presented in Chapters 4, 5 and 6, and other future research. Chapter 4 provides a detailed and nuanced understanding of the association between specific adolescent sleep disturbances and future self-harm thoughts and behaviours. Chapter 5 tests theoretically derived hypotheses in order to advance understanding regarding the psychological processes that underpin the relationship between sleep disturbance and self-harm risk. Chapter 6 examine these relationships within the context of daily life by investigating sleep disturbances and self-harm using a micro-longitudinal daily diary investigation.

Chapter 3 – Examining the role of sleep disturbance in relation to suicide and self-harm risk during adolescence: A systematic review and research agenda.

3.1. Chapter Overview

Preventing suicide and self-harm during adolescence is a global health priority. Chapter 2 highlighted that sleep is particularly vulnerable to disruption during adolescence and may represent a modifiable risk factor for these phenomena. The systematic review presented in this chapter aims to synthesise the extant literature examining the relationship between sleep problems and self-harm (irrespective of suicidal intent) in adolescents aged between 10-19 years old. A comprehensive search was conducted using seven e-databases (from their inception to June 2019) following a protocol registered on PROSPERO (CRD42017060173). Articles were independently screened to determine eligibility and methodological quality using predefined criteria. Given that there was considerable heterogeneity across studies, data was synthesised utilising a narrative approach. A total of 55 articles (n=1,067,584 adolescents) were included in the review.

The vast majority of evidence demonstrated that global assessments of sleep disturbance, symptoms of sleep disorders and problems, and specific sleep parameters, were all associated with increased vulnerability to self-harming and suicidal thoughts and behaviours. However, inconsistent patterns of results emerge when considering interrelations between specific sleep disturbances, depressive symptoms, and self-harm with and without suicidal intent. Overall, findings suggest that adolescents experiencing sleep problems are more likely to engage in self-harming and suicidal thoughts and behaviours. However, there was substantial

heterogeneity between studies, which complicates understanding of this relationship. A research agenda suggesting key directions for future research is proposed. Continued research in this area is essential in order to effectively identify, protect, and support young people who are vulnerable to self-harm.

3.2. Introduction

Suicide and (non-fatal) self-harm, defined as "self-injury or self-poisoning irrespective of the apparent purpose of the act" ((NICE), 2011; (NICE), 2004)), represent major public health concerns during adolescence (Geulayov et al., 2018; Mars et al., 2019). In order to effectively predict and prevent these phenomena in young people, there is a need to better understand factors that are associated with heightened vulnerability during this unique developmental period (Organization, 2014).

On account of bioregulatory, psychosocial, and societal pressures (Steinberg, 2016) specific to adolescence, young people worldwide are particularly vulnerable to experiencing disturbance across multiple dimensions of sleep. These include continuity, duration, timing, and quality (Crowley, Wolfson, Tarokh, & Carskadon, 2018; Gradisar et al., 2011). Adolescents also report frequent nightmares (Russell et al., 2018), and a significant proportion meet the diagnostic criteria for sleep disorders such as Insomnia Disorder (18.5% (Hysing et al., 2013)) and Delayed Sleep Phase Disorder (1%-16% (Gradisar & Crowley, 2013)). Given that sleep disturbances represent specific and modifiable targets for identification, prevention, and intervention, research investigating the role of sleep disturbance within self-harming and suicidal pathways has burgeoned in recent years. At this juncture, it is important

to survey the current state of the research field, identify the strengths and limitations

of existing evidence, and identify priorities for future research.

3.2.1. Rationale for the current review

Despite the scale of the problem, and the increased attention that has been

placed on suicide and self-harm, there is still a lack of consensus as to how these

phenomenon should be conceptualised (Silverman, 2016). Specifically, the extent to

which acts of self-harm can be discretely separated on the presence, or absence, of

suicidal intent is disputed (Kapur et al., 2013). To date, three systematic reviews

have examined the relationship between sleep disturbances and suicidal thoughts

and behaviours (i.e., those specifically associated with a desire to die). However,

since young people report that multiple, heterogeneous, motivations drive their

engagement in self-injury (Rasmussen et al., 2016), and that these reasons can

fluctuate over time (Townsend et al., 2016), the current review sought to extend the

extant literature by including all studies of self-harm irrespective of motivation (i.e.,

with and without suicidal intent). Specifically, we aimed to systematically synthesise,

and critically appraise, empirical evidence investigating the role of sleep disturbance

in relation to suicide and self-harm in young people.

Since not all young people who experience sleep disturbance will engage in

suicidal and self-harming thoughts and/or behaviours, there is a need to better

understand how and why poor sleep may contribute to their onset and repetition.

Here, a key first step is to determine which specific aspects of sleep are driving this

association. Previous systematic reviews examining the relationship between sleep

disturbance and suicide risk have made valuable contributions to the literature.

However, as a result of their specific aims, they have focused on a single sleep

parameter in isolation (i.e., sleep duration (Chiu, Lee, Chen, Lai, & Tu, 2018)) or on a narrow range of sleep problems (Kearns et al., 2018; Liu et al., 2019). Given the multidimensional, and wide ranging nature of adolescent sleep disturbance, there is a need for a systematic review, which examines all aspects of adolescent sleep in relation to self-harming and suicidal thoughts and behaviours. The current review sets out to achieve this.

The decision to evaluate empirical evidence concerning all self-injury or self-poisoning, irrespective of motivation or intent (vs. presenting suicidal and non-suicidal self-injury in separate reviews), was considered to be valuable for three main reasons. First, this approach accounts for the complexity and fluidity of the motivations underpinning self-harm in young people. Second, there is a robust association between suicide and (non-fatal) self-harm, such that the majority of young people who die by suicide have a history of self-harm (with or without suicidal intent) (Hawton et al., 2012). Consequently, self-harm can be viewed as a "gateway" to suicide (Whitlock et al., 2013), and may be key to suicide prevention. Third, this operationalisation is consistent with clinical practice guidelines, and so these findings have the potential to be relevant both clinically, and in the development of policy. In sum, we believe that in applying this broader conceptualisation of self-harm for the first time, the current review makes a meaningful contribution to the literature that extends beyond that of previous work.

3.3. Method

An *a priori* protocol for the current review was registered on PROSPERO, an international prospective register of systematic reviews (CRD42017060173).

3.3.1. Search strategy and screening procedure

This systematic review was conducted and reported in line with PRISMA guidance (Moher, Liberati, Tetzlaff, & Altman, 2009). A systematic literature search was conducted within seven e-databases (PubMed, Embase, PsychINFO, CENTRAL, Web of Science, CINAHL and ERIC) from their inception to June 1st 2019. Searches were implemented using key words which encompassed sleep and circadian disturbances (e.g., sleep* OR insomnia* OR nightmare* OR night terror* OR dyssomnia OR hypersomnia OR narcolepsy OR circadian rhythm*) and suicide/self-harm thoughts and behaviour (e.g., suicid* OR self-harm* OR self-injur* OR self-destructive behav* OR non-suicidal self-injur* OR NSSI). These were used in conjunction with population specific search terms (e.g., adolescen* OR teen* OR youth* OR young person* OR juv*). To be comprehensive and to ensure that no papers were missed in the original search, the reference lists for all included papers were hand searched, as were the reference lists for all major reviews and meta-analyses in the research area.

Articles that met the following eligibility criteria were included in the review:

1. An original empirical study published in the English language in a peer-reviewed journal (reviews, meta-analyses, comments, replies clinical guidelines, conference abstracts, theses, and book chapters were not included);

2. Included a measure of sleep disturbance (e.g., single items extracted from broader measures or standardised and validated measures);

3. Assessed self-harming thoughts and/or behaviours (with and without suicidal intent), including thoughts and behaviours irrespective of suicidal intent,

thoughts of non-suicidal self-injury, non-suicidal self-injurious acts, suicidal ideation, suicide plans, attempts and completed suicide;

4. Study participants must be young people aged 10-19 (based on the definition of adolescence employed by the World Health Organisation (2014)). Where articles included other age groups outside of this age range, in addition to adolescents, they were included if it was possible to discern the association between sleep and self-harm thoughts or behaviours in those aged 10-19 years old. Where a study was prospective in nature, the article was included where cross-sectional findings were reported and/or subsequent data collection took place within this age range. Where follow-up data collection extended beyond the age of 19, and baseline findings were not reported, articles were excluded.

Both quantitative and qualitative research methodologies were considered for inclusion. The first author (KR) conducted the literature search, removed duplicate articles and evaluated the eligibility of all identified citations against predetermined inclusion criteria. At each stage of title, abstract, and full-text selection, 50% of the articles were independently evaluated by a second reviewer (RM). Pertinent details from each study were extracted by one reviewer (KR) using a pre-tested standardised data extraction form. Where relevant variables were measured, but not reported, authors were contacted to request additional information (Figure 3.1).

To critically appraise the quality of the evidence, an adapted version of the Newcastle Ottawa Scale was employed. Assessment criteria relating to the research methodology and analysis and the evidence was graded as low (0-3), moderate (4-6) and high quality (7-9). Quality assessments were initially undertaken by the first author and 50% were screened by an additional reviewer (BM). Disagreements

regarding the methodological quality of the included studies were resolved through

discussion, until a consensus was reached. Total quality ratings are included in

Table 3.1. It was intended that a random-effects meta-analysis would be conducted.

However, this was not possible due to heterogeneity in study designs, measurement

tools, and data-analytic procedures. As a result, a narrative approach was taken to

synthesise the available evidence.
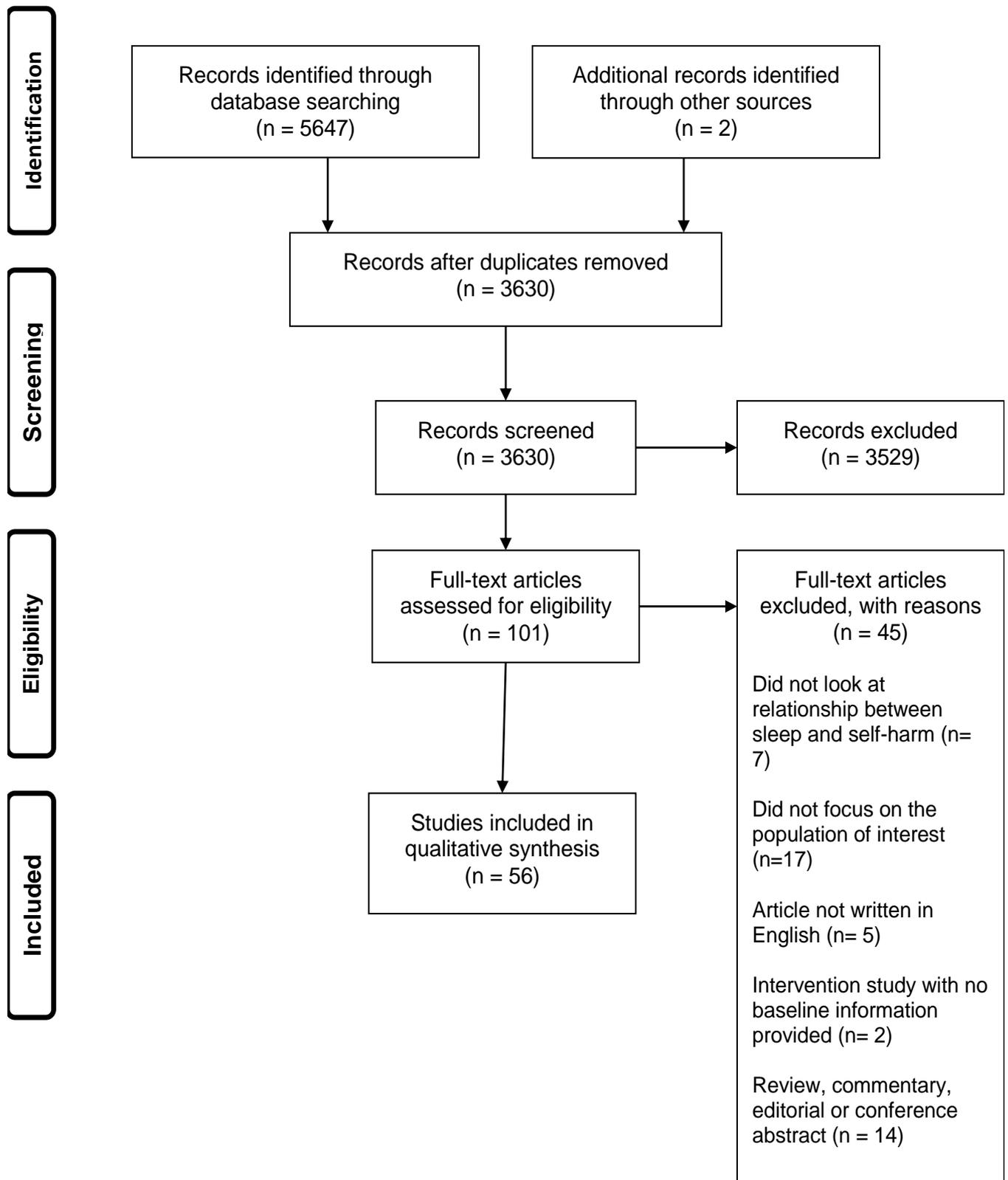
Figure 3. 1. PRISMA diagram illustrating procedure for identifying the eligibility of studies for inclusion in the review

3.4. Results

3.4.1. Study characteristics: Participants, sampling, and design

A total of 5,647 unique citations were identified, with 2 additional studies identified through reference checking. This search strategy yielded 56 unique studies, which met the full eligibility criteria, and were reported in 55 original peer reviewed articles (summarised in Table 1). Across the studies, there were 1,067,584 participants with a mean age of 15.5 years old (range: 10-19 years old), and 28.7% to 100% of the samples identified as female. The majority of these studies were conducted in the US (n=15) and Korea (n=13), with the remaining investigations taking place in Australia, Brazil, Canada, China, France, Germany, Great Britain, Israel, Japan, Mongolia, The Netherlands, Norway, Sweden, and Taiwan. One article presented results from the Saving and Empowering Young Lives in Europe (SEYLE) project, and shares data collected across 11 European countries (Sarchiapone et al., 2014). All studies employed a quantitative approach, and no qualitative or mixed-methods investigations were identified. The vast majority of studies (n=46) were cross-sectional in design with a further six prospective studies, three case-control studies and one retrospective audit of hospital records also being identified. The prospective studies reported follow-up periods ranging from one to four years, and response rates were acceptable (80%-87%). The majority of included studies were conducted in non-clinical settings and data were collected via school-based surveys (n=38), population-based surveys (n=8) and web-based surveys (n=5). Five investigations (8.7%) were conducted in clinical settings such as community mental health services or adolescent mental health inpatient units.

Table 3. 1. Summary of studies examining the relationship between sleep disturbance and suicidal and self-harming outcomes in adolescents.

Study	Sample characteristics	Design	Sleep disturbance outcome and time frame	Self-harm/suicide risk outcome and time frame	Confounding variables	Main finding
Altangerel et al. (2014) QA Score: 3	5,148 adolescents aged 12-18 Mage = NA, % female: NA Mongolia: Global School Based Health Survey (2010)	Cross-sectional	Insomnia (Could not sleep – yes/no) Assessment period: N/A	Suicidal behaviour (defined as ideation, plan or and/or attempt) Single items (e.g. During the last year, did you every seriously consider attempting suicide?) Assessment period: past year	Sex, grade level, location, living conditions, absence of close friends, loneliness, bullying, and perception of being overweight	Young people who could not sleep were more likely to report suicidal behaviour than adolescents who slept well (ideation: AOR: 1.56; plans: AOR: 1.53; attempts: AOR: 2.74).
Alves et al. (2016) QA Score: 3	1,132 adolescents aged 14-19 Mage = NA, 45.8% female Brazil: school-based study	Cross-sectional	Sleep quality (Do you sleep well and feel rested – yes/no) Assessment period: N/A	Suicidal behaviour (defined as ideation, plan or and/or attempt) Single items taken from the YRBS (e.g. During the past 12 months, how many times did you actually attempt suicide?)	Age, skin colour, economic status, physical activity, alcohol intake and perception of body weight	There was a higher prevalence of suicidal thoughts, plans and attempts in teenagers who did not sleep well (ideation: AOR: 2.42; plans: AOR: 2.29; attempts: AOR: 2.47).

				Assessment period: past year		
An et al. (2010) QA Score: 3	2965 adolescents aged 15-19 Mage = 16.2, 48.9% female Korea: Korean Social Statistical Survey (2006)	Cross-sectional	Insufficient sleep (Are you getting enough sleep (defined by the authors as 6-8 hours)?– yes/no)) Assessment period: current	Suicidal ideation Single item (e.g. during the past year, have you ever thought you wanted to commit suicide?) Assessment period: past year	Sex, eating breakfast, regular exercise, satisfaction with health, satisfaction with family and parents, paternal employment status, maternal sleep and health status, parental history of suicidal ideation and satisfaction with family	Adolescents who reported insufficient sleep were at elevated risk of having experienced suicidal ideation (AOR: 1.43).
Bandel & Brausch (2020) QA Score: 6	387 adolescents aged 13-19 Mage =14.2, 52.0% female U.S: school-based survey	Cross-sectional	Insomnia symptoms (SCI) and sleep quality (PSQI) Assessment period: past month	NSSI engagement (ISAS) Assessment period: past 6 month	Depressive symptoms (RADS-2)	More adolescents who had engaged in NSSI in the past six months reported poorer sleep quality (80.6%) and were more likely to score above the clinical threshold for insomnia symptoms, (27.3%) compared to those without recent NSSI (45.0% and 5.8% respectively).

Hierarchical logistic regression analyses demonstrated that after controlling for depression symptoms, insomnia symptoms (AOR: 1.15) but not sleep quality (p=0.23), predicted NSSI engagement in the past 6 months.

Poor sleep was not associated with NSSI severity (i.e. frequency and number of methods used).

| **Blank et al. (2015)**

QA Score: 5 | 6,483 adolescents aged 13-18. Mage = NA, % female: NA

U.S: population-based survey (NCS-A) | Cross-sectional | Insomnia symptoms (DIS, DMS, EMA nearly every day for at least 2 weeks during the past year – yes/no?)

Assessment period: past year | Suicidality (defined as any suicidal thought, plan or attempts) and intentional injury (WHO CIDI)

Assessment period: past year | Age, sex, ethnicity and a range of mental health disorders (e.g. mood, anxiety, behaviour & eating disorders in past 12 months (WHO CIDI) | Insomnia symptoms, even in the absence of comorbid mental health problems, are associated with suicidality (AOR: 2.63) and intentional self-harm (AOR: 1.99). Adolescents reporting symptoms of insomnia and mental health problems were at even greater risk of suicidality (AOR: 21.20) and self-harm (AOR: 3.19). |
| **Borschmann et al. (2018)**

QA Score: 2 | 212 adolescents aged 12-17. Mage = 15.4, 78.8% female | 12-month retrospective audit of adolescents admissions to mental health inpatient unit | Routinely collected data on any sleep problems that the young person experienced | Admission to mental health inpatient unit for suicidal behaviour (ideation, plans or attempts)

Assessment period: past year | Only descriptive results (i.e. frequencies) provided | The majority (75%) of young people admitted to the mental health inpatient unit, following suicidal behaviour, reported sleeping difficulties prior to their admission. |

	Australia: mental health inpatient unit within one children's hospital			prior to admission Assessment period: NA			
Choquet et al. (1990) QA Score: 3	1,601 adolescents aged 13-16 Mage = N/A, 47.1% female France: school-based survey	Cross-sectional	Frequent tiredness, frequent nightmares, waking up often during the night, and sleeping for less than 7 hours Assessment period: past year	Suicidal ideation Single item (e.g. During the last year, I have thought about suicide – never, rarely, fairly often, or very often) Assessment period: past year	Analysis did not statistically control for any confounding variables	Young people experiencing tiredness, frequent nightmares, wakefulness during the night, and sleep less than 7 hours were more likely to have experienced suicidal thoughts in the past year than those who did not report sleep problems (p<0.001).
Choquet et al. (1993) QA Score: 2	598 adolescents aged 15-19 Mage = N/A, % female: NA France and Canada (Quebec): school/home-based survey	Cross-sectional	Experience of sleep difficulties, tiredness and less than 7 hours sleep per night Assessment period: past year	Suicidal thoughts Single item (e.g. During the last year, I have thought about suicide – never, rarely, fairly often, or very often) Assessment period: past year	Analysis did not statistically control for any confounding variables	Adolescents with a history of suicidal ideation in the past year reported more sleep difficulties (OR: 3.4), complained more frequently of daytime tiredness (OR: 2.0) and slept less (OR: 1.7).

Chung et al. (2014) QA Score: 4	605 adolescents aged 10-13 Mage = 13.1, 50.2% female Taiwan: school-based survey	Cross-sectional	Frequency of poor sleep in a week – none or seldom, sometimes, frequently, and always. Assessment period: past week	Suicidality (MINI-Kid) Five items: thoughts, plans and actions Assessment period: past month	Sex, grade, parental education and employment status, parental marital status, caregiver, depressive disorder and adjustment disorder	Within unadjusted analyses, poor sleep (sometimes AOR: 1.75; frequent AOR: 2.31; always AOR: 2.79) was significantly associated with suicidality. This relationship was independent of depressive disorder, but not adjustment disorder.
Do et al. (2013) QA Score: 4	136,589 adolescents aged 13-18 Mage = N/A, 47.7% female South Korea: 2008-2009 YRBS (school-based survey)	Cross-sectional	Self-reported average weekday sleep duration (Monday to Friday) – categorical response (e.g.<4h, 4-5 h, 5-6 h, 6-7 h, 7-8h , 8h>) Assessment period: past week	Suicidal ideation Single item (e.g. During the past 12 months, did you ever seriously consider attempting suicide?) Assessment period: past year	Sex, father's and mother's education, household economic status, type of residential area, school grade, excessive internet use, and survey year	Adolescents who reported sleeping for less than 8 hours per night were more likely to have experienced suicidal ideation, than those sleeping for 8 hours or more (<4h, $r = 0.93$, 4-5h, $r=0.61$, 5-6h, $r=0.35$), 6-7, $r=0.17$).
Fitzgerald et al. (2011a) QA Score: 5	12,154 adolescents aged 12-18 Mage = 16.1, 47.9% female	Cross-sectional	Self-reported average school-night sleep duration - categorical response (≤ 4	Suicidality (ideation, plans, attempt & attempt leading to treatment)	Sex, age, ethnicity and sadness (assessed with a single item:	Young people reporting short (<5 hours) and long (>10 hours) sleep were at significantly greater risk of reporting all aspects of suicidality compared to those

Study	Sample	Design	Sleep measure	Suicidality measure	Covariates	Findings
	U.S 2007 YRBS (school-based survey)		h, 5 h, 6 h, 7 h, 8 h, 9 h, and ≥ 10 h) Assessment period: current	Single items (e.g. During the past 12 months, did you make a plan about how you would attempt suicide?) Assessment period: past year	During the past 12 months, did you ever feel so sad or hopeless almost every day for 2 weeks or more in a row that you stopped doing some usual activities?)	with a sleep duration of eight hours. The largest risk was found amongst those reporting suicide attempts. These findings were independent of feelings of sadness.
Fitzgerald et al. (2011b) QA Score: 5	14,782 adolescents aged 12-18 Mage = 16.2, 47.8% female U.S 2009 YRBS (school-based survey)	Cross-sectional	Self-reported average school-night sleep duration - categorical response (≤ 4 h, 5 h, 6 h, 7 h, **8 h**, 9 h, and ≥ 10 h) Assessment period: current	Suicidality (ideation, plans, attempt & attempt leading to treatment (e.g. same items as Fitzgerald, 2011a) Assessment period: past year	Sex, age, ethnicity and sadness (assessed using the same item as Fitzgerald, 2011a)	Young people reporting short (<5 hours) and long (>10 hours) sleep were at significantly greater risk of reporting all aspects of suicidality compared to those with a sleep duration of eight hours. The largest risk was found amongst those reporting suicide attempts. These findings were independent of feelings of sadness.
Gangwisch et al. (2010) QA Score: 5	15,659 adolescents aged 12-15 Mage = NA, 48.9% female	Cross-sectional	Parental set bedtime, average sleep duration and perception of getting enough sleep	Suicidal ideation Single item (e.g. During the past 12 months, did you ever seriously think	Sex, age, parents' marital status, family's receipt of public assistance and	Adolescents with parental set bedtimes of midnight or later were more likely to report suicidal ideation (OR: 1.20) than adolescents with a parental set bedtime of 10pm or earlier, after controlling for

				about committing suicide?) Assessment period: past year	depression (CES-D)	covariates. Both sleep duration (<6 hours) and perception of not getting enough sleep partially mediated this relationship.
US: Add Health survey (school and home-based)			Assessment period: current			
Gau et al. (1999) QA Score: 4	60 adolescents aged 13-15 Mage = 14.5, 56.8% female China: school-based survey	Case-control	Sleep terrors and sleep walking Assessment period: past year	Suicidal ideation and attempts (Chinese version of the K-SADS-E) Assessment period: past year	Analysis did not statistically control for any confounding variables	Adolescents who experienced sleep terrors or sleep walking in the past month were at increased risk of suicidal ideation (OR: 14.50), but not suicide attempts.
Gau et al. (2007) QA Score: 6	1,332 adolescents aged 12-13 Mage = 14.5, 48.8% female China: school-based survey.	Cross-sectional	Morningness-Eveningness (Chinese version of the CMES) Assessment period: current	Suicidal tendency (ideation and/or attempts) Single items completed by adolescent (e.g. I think about killing myself) and parent (e.g. child talks about killing self) Assessment period: NA	Sex, pubertal stage (PDS), fathers education level, trouble sleeping, daytime napping and internalising and externalising problems (CBCL, completed by parents)	Suicidality was more prevalent in the evening group (34.4%) than in the morning (18.5%) or intermediate (20.5%) group. The magnitude of the relationship between eveningness and suicidal thoughts and/or attempts decreased when controlling for emotional and behaviour problems, but remained statistically significant (Eveningness vs. Morningness AOR: 1.3; Eveningness vs. Intermediate AOR: 1.5).
Goldstein et al. (2008) QA Score: 8	271 adolescents (140 who had died by suicide,	Case- control Cases: Psychological	Overall sleep disturbance (6 sleep items in K-SADS-E	Suicide death (case vs. community control)	Sex, presence of affective disorders, presence of	Overall rates of sleep disturbance, insomnia and hypersomnia were higher in those who died by suicide in

and 131 matched community controls) aged 13-19 Mage Case = 17.3, 15.0% female Mage Control = 17.5, 30% female US: community-based investigation	autopsy (Parents, siblings and friends of young people who had died by suicide were interviewed 4-6 months after death) Controls: Community controls and their parents participated in semi-structured interviews		depression section e.g. hypersomnia and insomnia) Assessment period: Case – week preceding death my suicide and in the most recent depressive episode Control – previous week and during current depressive episode		substance use disorder, presence of conduct disorder (K-SADS-E)	the week preceding death (vs. the previous week for community controls) and in the most recent depressive episode (vs. current episode for community controls). Differences between groups in overall sleep disturbance and insomnia (but not hypersomnia) persisted when controlling for current depressive severity. More adolescents who died by suicide exhibited worsening of sleep disturbance in their final week relative to community controls.
Guo et al. (2015) QA Score: 5	3,186 adolescents aged 13-18 Mage = 15.6, 46.6% female China: school-based survey	Cross-sectional	Sleep quality and disturbances (Chinese PSQI) Assessment period: past month	Suicidal ideation, suicide attempts and self-harm Single items (e.g. During the past 12 months, did you ever hurt yourself on purpose?) Assessment period: past year	Sex, age, sleeping after lunch, family relationships, academic pressure, relationships with teachers, feeling lonely, running away from home and	Adolescent's experience of sleep disturbance in young people was associated with suicidal ideation, suicide attempts and self-harm.

					depressive symptoms	
Guo et al. (2017) QA Score: 4	20,130 adolescents aged 13-20 Mage = 16.3, 54.6% female China: school-based study	Cross-sectional	Average school day sleep duration – categorical response (5–7 h," "**7–9 h**," or "≥9 h") Assessment period: current	Suicidal ideation and attempts Single items (e.g. During the past 12 months, how many times did you seriously consider attempting suicide?) Assessment period: past year	Age, sex ,living arrangements, household socioeconomic status, family relationships,, classmate relations, teacher-classmate relations, current smoking, and current drinking status	Short sleep was positively associated with suicidal ideation (<5 h AOR=2.28, 5-7h AOR: 1.59) and suicide attempts (<5h AOR: 3.20, 5-7h AOR: 1.53). Long sleep (>9h) was associated with suicide attempts (AOR: 2.47) but not ideation. Therefore, the relationship between sleep duration and attempts is U-shaped. Depressive symptoms (CES-D) may have moderating effects on this association, such that relationships were only significant in those without depressive symptoms.
Hysing et al. (2014) QA Score: 5	10 220 adolescents aged 16–19 Mage = 17.9, 53.3% female Norway: population-based study	Cross-sectional	Insomnia symptoms operationalised according to DSM-V criteria (DIS and/or DMS at ≥ 3 times a week, for a duration of ≥ 3 months, as well as tiredness/sleepiness for ≥ 3 days a week)	Self-harm (with and without suicidal intent) Self-harm item from CASE study: Have you ever deliberately taken an overdose (e.g. of pills or other medication) or tried to harm yourself in some other way	Age, sex, maternal and paternal education, family economy, depressive symptoms (SMFQ), ADHD (ASRS inattention and hyperactivity/ impulsivity scales) and	Adolescent with sleep problems were significantly more likely to report self-harm than those without sleep problems. Insomnia (AOR: 1.73) short sleep duration (AOR: 1.78), long sleep onset latency (AOR: 1.36), wake after sleep onset (AOR: 1.50) large differences between weekdays vs. weekends (AOR: 1.29) and greater sleep deficiency (AOR: 1.46) were associated with higher odds of

			Sleep duration (hours, and sleeper category (short, normal and long)), sleep onset latency wake after sleep onset, sleep deficiency, bedtime difference, napping Assessment period: current	(such as cut yourself? Assessment period: lifetime, with follow up questions about the most recent episode	perfectionism (EDI)	self-harm. There were significant dose–response associations between sleep problems and the frequency of self-harm. Depressive symptoms did account for some but not all of the relationships between sleep and self-harm.
Im et al. (2017) QA Score: 3	370,568 adolescents aged 13-19 Mage = NA, 48.6% female Korea: YRBS 2009-2013	Cross-sectional	Sleep satisfaction – categorical response (not enough at all, not enough, a little, enough, plenty) Assessment period: NA	Suicidal ideation Single item (YRBS, I have thought about suicide seriously in the previous 12 months) Assessment period: past year	No confounding variables accounted for in analyses	Low sleep satisfaction (i.e. perception of not getting enough sleep) is associated with increased risk of suicidal ideation during adolescence.
Jang et al. (2013) QA Score: 5	75,066 adolescents aged 12-18	Cross-sectional	Current average weekday sleep duration –	Suicidal ideation and attempts	Sex, socioeconomic factors, self-rated health,	There was a negative relationship between sleep duration and suicidal ideation/ attempts. Adolescents

	Mage = NA, 49.0% female Korea: YRBS 2009		categorical response (0 to 4 hours, 4 to 5 hours, 5 to 6 hours, 6 to 7 hours, 7 to 8 hours, and 8 hours or more) Assessment period: current	Single items (YRBS, Have you thought attempted suicide in the past 12 months?) Assessment period: past year	drinking alcohol/ smoking/ drug use, physical activity and depressed mood (Have you had a sense of sadness or hopelessness to an extent that you had to stop your daily activities for at least two weeks?)	reporting less than 4 hours' sleep (compared to 6-7 hours) demonstrated higher odds of suicidal ideation (Male AOR: 1.72; Female AOR: 2.68) and attempts (Male AOR: 1.35; Female AOR: 1.71). The relationship between sleep duration and suicidality was weaker in those reporting depressed mood.
Jia et al. (2016) QA Score: 4	1,378 adolescent aged 15-18 Mage = 17.2, 51.6% female China: Rural school based study	Cross-sectional	Past month average sleep duration (hours: minutes) and the impact that nightmares have on adolescents life (assessed using a 14 item measure, assessment period: NA)	Suicidal ideation Single item (e.g. During the last year, did you ever consider committing suicide?) Assessment period: past year	Parental education, family environment, mental health status (i.e. poor, average or good), smoking and physical activity	There were significant differences in sleep duration and nightmares between young people with a past year history of suicidal ideation and those without. Nightmares (AOR: 1.05) were positively associated with suicidal ideation, and sleep duration (AOR: 0.72) was negatively associated with suicidal ideation.

| Kang et al. (2014)

QA Score: 5 | 4,145 adolescents aged 13-17
Mage = 15.3, 44.6% female

Korea: school based survey | Cross-sectional | Sleep duration on weekdays and weekends, weekend catch-up sleep (weekend sleep duration – weekday sleep duration)

Assessment period: current | Suicidal ideation (Korean version of SIQ) and suicide attempt/self-injury (e.g. Have you made any intentional suicide attempt or performed any self-injury over the past year)

Assessment period: past month (suicidal ideation) and past year (suicide attempt/self-injury) | Age, sex, depressive symptoms (BDI), time spent in an educational institute and self-reported academic record | Young people with short (≤ 7 hours) weekday sleep duration and longer weekend catch up sleep scored higher on the SIQ compared with those who slept for more than 7 hours. There were no significant differences in the frequency of young people reporting suicide/self-harm between sleep duration groups (e.g. <7 h vs. ≥ 7 h sleep) -. Longer weekend catch up sleep (but not weekend sleep duration) was associated with a higher score on the SIQ (β = 0.48, p = 0.009 as well as self-injury/suicide attempt in the past year (AOR: 1.13). |
| Kaplan et al. (2014)

QA Score: 4 | 50 adolescents aged 12-17
Mage = 15.1, 64.0% female

US: Adolescent inpatient unit | Cross-sectional | Sleep quality (ASWS), sleep hygiene (ASHS), sleep-related cognitions (DBAS-C10) and nightmares (DDNSI)

Assessment period: past month | Suicidal ideation (SIQ-JR)

Assessment period: past month | Age, sex | Sleep quality, dysfunctional beliefs about sleep, and clinically salient nightmares were independently associated with suicidal ideation. |

Kim et al. (2015) QA Score: 5	19,1642 adolescents aged 12-18 Mage = NA, 48.2% female Korea: 2011-2013 YRBS (web-based survey)	Cross-sectional	Time in bed (calculated from reported bed and awakening times) – categorical outcome (≤4, 5, 6, 7, 8, 9 and ≥10 h) Assessment period: current	Suicide ideation, plans and attempts Single item questions (e.g. Have you had suicidal plans in the past 12 months?) Assessment period: past year	Age, sex, socioeconomic status, drug, smoking and alcohol history, exercise (past week) and depression (Have you ever experienced a deep sense of sadness or despair in the past 12 months?)	Adolescents with a very short time in bed (< 7 hours) are at increased risk of suicidal ideation (AOR: 1.49), plans (AOR: 1.47) and attempts (AOR: 1.81) relative to those reporting 7 hours in bed.
Kim et al. (2016) QA Score: 4	58,848 adolescents aged 12-18 Mage = 15.0, 48.9% female Korea: 2014 YRBS (web-based survey)	Cross-sectional	Week day sleep duration (calculated from usual weekday bed and awakening time) and sleep satisfaction (adolescents perception of whether they are obtaining sufficient sleep to recover from fatigue) Assessment period: past week	Suicidal ideation Single item (e.g. For the last 12 months, have you ever seriously thought about suicide?) Assessment period: past year	Age, sex, BMI, school type, urban scale, living arrangement, parents educational background, perceived economic status, perceived school performance, subjective health status, stress awareness, depression	Young people sleeping for less than four hours were more likely (AOR: 1.36) to report suicidal ideation than those sleeping for more than nine hours. Adolescents who were moderately satisfied (AOR: 1.20), unsatisfied (AOR: 1.38), and very unsatisfied (AOR: 1.64) with their sleep were at increased risk of suicidal ideation.

						awareness, life time drinking, smoking, drug use and sexual intercourse
Koyawala et al. (2015) QA Score: 7	80 adolescents (40 cases/40 matched controls) aged 13-16 Mage = 15.5, 75.0% female US: Community health service/hospital based study	Case-control Cases: History of suicide attempt Controls: No history of suicide attempt or ideation	Sleep problems Young people: BEARS Sleep Screening Questionnaire (difficulty initiating sleep. daytime sleepiness, night-time wakefulness, difficulties waking in the morning), bedtime and wake-time on weekdays and weekends Parents: Perception of whether their child was getting enough sleep and parents perception of	Suicide attempt Young people and parents were interviewed using the Columbia University Suicide History Form Assessment period: lifetime (young people who reported suicide in the past year were included in the case group) Young people reporting NSSI were excluded from this study	Sex, affective problems (CBCL), bullying perpetration and victimisation, psychotropic medication use.	Self-reported night-time awakenings (AOR: 4.13), and parent reported total sleep problems (BEARS) score (AOR: 2.15), were both associated with suicide attempts when controlling for key covariates. No associations were found between suicide attempts and other distinct sleep problems, including falling asleep at bedtime, sleeping a lot during the day, trouble waking up in the morning, sleep duration, and parent reported nightmares

			their child's experience of nightmares in past six months (CBCL) Assessment period: with the exception of nightmares, a timeframe was not specified			
Lee et al. (2012) QA Score: 5	8010 adolescents aged 13-18 Mage = 16.7, 60.4% female Korea: School-based study	Cross-sectional	Behaviourally induced insufficient sleep syndrome (BISS), Insomnia (defined as DIS, DMS and/or EMA > 3 times a week over the past month), Morningness-Eveningness (KtCS), Presence of significant snoring (defined as snoring ≥ 3 times/week)	Suicidal ideation (SSI – Korean Version) Assessment period: past week	Age, sex and depressive symptoms (BDI)	Longer weekend oversleep (β = 0.07, p <0.01), larger weekend rise time delay (β = 0.07, p<0.01) and lower eveningness (β = -0.03 p <0.001) predicted a higher SSI score, which indicates that weekend oversleep is an independent predictor of suicidality. These effects were independent of depressive symptomology. Weekday sleep duration (β = -0.37, p <0.001) and weekend bedtime delay (β = 0.15, p <0.001) were associated with SSI score. However, these relationships disappear when depressive symptoms are accounted for.

Adolescents with BISS were found to have significantly higher SSI scores than those without BISS.

Liu (2004) QA Score: 5	1,362 adolescents aged 12-17 Mage = 14.6, 40% female China: school-based survey	Cross-sectional	Sleep patterns and problems Average sleep duration, DIS, DMS, EMA, nightmares, late bedtime (after midnight) and use of medication to help sleep Insomnia (single item questions on DIS, DMS, EMA) Assessment period: past month	Suicidal ideation and suicide attempts 2 items from the Chinese version of YSR (e.g. I think about killing myself, I deliberately try to hurt of kill myself) Assessment period: current and within the past six months	Age, sex, father's occupation depressive symptoms (YSR depression subscale)	Sleeping less than 7 hours at night (OR: 2.43), all types of insomnia (OR: 1.74) and nightmares (AOR: 1.69) were significantly associated with suicidal ideation. However, only the relationship between nightmares and suicidal thoughts was significant after adjusting for the effect of depressive symptoms and demographic variables. Sleeping less than 8 hours at night (AOR: 2.89) and frequent nightmares (AOR: 2.43) were significantly associated with increased risk for suicide attempts after adjustment for demographics and depressive symptoms. Insomnia (OR: 2.30) was related to suicide attempts. However, this effect did not remain significant within the multivariate analysis.

Liu et al. (2017) QA Score: 5	2,090 adolescents aged 12-18 Mage = 15.5, 50.9% female China: school-based survey	Cross-sectional	Sleep patterns and sleep problems (AHQ): Usual bedtime, usual wake time, sleep onset latency, average week and weekend sleep duration and napping. Sleep quality, sleep sufficiency, and sleep satisfaction. insomnia symptoms (DIS, DMS, EMA), daytime sleepiness and fatigue, frequency of nightmares in the past month/year Assessment period: past month	Non-suicidal self-injury (NSSI) Assessed using the AHQ (e.g. I have tried to hurt myself deliberately without intention to kill myself) Assessment period: lifetime and past year	Age, sex, grade, school district, physical exercise, self-perceived health, family SES, internalising and externalising problems (YSR), hopelessness (BHS) and impulsiveness (Eysenck I7 impulsiveness scale)	Univariate analyses demonstrated that multiple sleep variables including short weekday (<8 hours) and weekend (<6 hours) sleep duration , insomnia symptoms, poor sleep quality, sleep insufficiency, unrefreshed sleep, sleep dissatisfaction, daytime sleepiness, fatigue, snoring, and nightmares were associated with increased risk of NSSI. After adjusting for demographic and mental health variables, NSSI was significantly associated with sleeping <6 hours per night (AOR: 1.96), poor sleep quality (AOR: 2.17), sleep dissatisfaction (AOR: 1.84) and frequent nightmares (AOR: 2.96). Poor sleep quality (AOR: 2.13) and nightmares (AOR: 1.63) were independent risk factors of NSSI.
Liu et al. (2018)	7,072 adolescents aged 13-18	Prospective (12 months)	Daytime sleepiness (CADSS),	Suicidal ideation plans and attempts.	Age, sex, history of smoking	Within the adjusted analysis, elevated daytime sleepiness was associated with increased

QA Score: 7	Mage = 14.6, 48.1% female China: school-based survey	Follow up rate: 82.0%	school night sleep duration insomnia symptoms (DIS, DMS, EMA ≥ 3 times per week) and snoring (AHQ) Assessment period: past month	Single items (e.g. Have you ever seriously thought about suicide or killing yourself?) Assessment period: lifetime	and/or drinking, school, family demographics (e.g. fathers education/ occupation, family history of suicide or attempt, family economic status, inter-parental relationship) anxious/ depressive symptoms, impulsiveness, hopelessness	risk of subsequent suicidal thoughts (AOR: 1.55) and plans (AOR: 2.60), but not attempts. Sleep duration, insomnia and snoring were not significantly associated with incident suicidal thoughts, plans or behaviours after adjusting for adolescent and family covariates.
Lundh et al. (2013) QA Score: 7	881 adolescents aged 13-15 Mage = 14.6, 49.2% female Sweden: school-based study	Prospective (12 months) Follow up rate: 84.0%	Sleep problems (Do you sleep well? – Categorical response (Always, Most often, Sometimes, Seldom, and Never) Assessment period: current	NSSI (DSHI-9r) Assessment period: past six months	Psychological problems (SDQ-s) Assessment period: past six months	Poor sleep is a risk factor for the prospective development of NSSI among young girls (r=0.19, p<0.00), even when the degree of general psychopathology and baseline NSSI were controlled for). However, this relationship was not replicated in boys.

Matamura et al. (2014) QA Score: 2	60 pairs of adolescent twins aged 12-18 Mage = NA, 63.3% female Japan: Twin school-based study	Cross-sectional	Usual sleep and wake times on school days and bedtime regularity Assessment period: current	Suicidal thoughts and self-harm behaviours Single items: NA Assessment period: NA	Age and sex.	Late bedtime and short sleep duration were associated with subsequent suicidal thoughts and self-harm. These associations were significant even after controlling for bedtime regularity and shared genetic and environmental factors of the twins. However, bedtime regularity was not associated with these outcomes.
McGlinchey et al. (2017) QA Score: 5 34	223 adolescents aged 11-19 Mage= 14.9, 72% females US: community mental health clinic-based study	Cross-sectional	Sleep difficulties (insomnia (DIS/ DMS/ EMA) circadian reversal, non-restorative sleep, and hypersomnia) K-SADS present and lifetime version Assessment period: current	Suicidal ideation (SIQ-Jr) NSSI and SA history and frequency (BAASSI (e.g. Have you ever hurt yourself on purpose without wanting to die?, In your whole life, how many times have you hurt yourself on purpose without wanting to die?))	Sex, age, ethnicity and depression (BDI)	Patients with significant sleep complaints at the time of clinical entry endorsed significantly more engagement in non-suicidal self-injury. There were significant no differences between the groups for either suicide attempt or suicidal ideation. Adjusting for demographic factors and self, reported depression, waking in the middle of the night ($\beta = 0.18$, $p = 0.03$) and reversal in circadian timing $\beta = 0.18$, $p = 0.04$) were both significant predictors of suicide attempts. Waking up early and being unable to return to sleep was significantly associated with suicidal ideation ($\beta = 0.18$, $p =$

0.01). None of the specific sleep difficulties predicted NSSI. Initial insomnia and hypersomnia did not predict any of the measures of self-harm (i.e. suicidal or non-suicidal).

McKnight-Eily et al. (2011) QA Score: 3 35	12,154 adolescents aged 13-18 Mage = NA, 49.7% females US: 2007 YRBS	Cross-sectional	Insufficient sleep (defined as < 8 hours on average on school nights) Assessment period: current	Suicidal ideation Single item (e.g. seriously considered attempting suicide during the 12 months before the survey) Assessment period: past year	Age, sex and ethnicity.	Insufficient sleep on an average school night was associated with increased risk of experiencing suicidal ideation in both males and females (AOR: 1.86)
Nrugham et al. (2008) QA Score: 7	2464 adolescents aged 13-15 MageT1 = 13.7, 50.8% females MageT2 = 14.9, 50.3% females Norway: school based sample	Prospective (12 months) Follow up rate:86.7%	Insomnia (DIS, DMS and EMA), circadian reversal, non-restorative sleep and hypersomnia (KL-SADS-PL) Assessment period: current and lifetime	Suicide attempts (MFQ & K-SADS-PL) Single item (e.g. Have you ever tried to commit suicide?) Assessment period: lifetime and since last interview	Presence of depressive disorders (MFQ & K-SADS-PL)	Difficulties falling asleep, non-restorative sleep and reversal in circadian timing associated with lifetime history of suicide attempts at age 15.

Park et al. (2013) QA Score: 4	78,843 adolescents aged 12-18 Mage: NA, 46.9% females. Korea: 2007 YRBS (web-based survey)	Cross-sectional	Weeknight seep duration (e.g. <4, 4–<5, 5–<6, 6–<7, 7–<8 and >8) and non-restorative sleep. Assessment period: past week	Suicidal ideation and attempts. Single items (e.g. Have you attempted suicide in the past 12 months?) Assessment period: past year	Sex, grade, family living structure, economic status, academic performance, cigarette smoking (past month), alcohol drinking (past month) and subjective feeling of depression (e.g. experiencing depression or frustration for 2 weeks or more over the last year?)	Fewer than 4 h of sleep (AOR: 1.43) and a lack of feeling refreshed after sleeping (AOR: 1.91) increased the likelihood of suicidal ideation. Nonrestorative sleep was related to suicide attempts in bivariate, but not multivariate analyses. Sleeping for less than 4 hours was not associated with a history of suicide attempts.
Park et al. (2017) QA Score: 4	59,591 adolescents aged 12-18 Mage 15.0, 49.1% females Korea: 2007 YRBS (web-based survey)	Cross-sectional	Weekday sleep duration (calculated from sleep onset and wake up time, and divided into categories: **> 8**, 7–8, 6–7, 5–6, 4–5 h,	Suicidal thoughts, planning and attempts Single items (e.g. During the last 12 months, have you ever made a concrete plan to commit suicide?)	School type, school achievement, family economy status, residential area, living arrangement, subjective health, stress,	There was a significant inverse relationship between all suicide related outcomes and weekday sleep duration in Korean adolescents. This association was independent of related factors including depressed mood. Those sleeping for less than 4 hours per night were at the greatest risk suicidal ideation, plans and attempts

			and less than 4 h) Assessment period: current	Assessment period: past year	happiness, BMI, smoking, drinking, physical activity, weekly allowance, depressed mood (feeling sad/ desperate for 2 weeks or more in past year)	compared to young people who reported sleeping for 8 hours or more.
Park et al. (2019) QA Score: 3	12, 046 adolescents aged 13-16 Mage: NA, 100% female Korea: Korean Juvenile Health Behaviour Online Survey (2017)	Cross-sectional	Average sleep duration per night (e.g. <8 h, and >8 h) Assessment period: current	Suicidal ideation Single item (e.g. Have you ever seriously considered suicide during the last 12 months?). Assessment period: past year	Depressive experience (sadness/ despair for more than two consecutive weeks in the past year), perceived economic status, living arrangement, smoking, current smoking/ alcohol consumption status, perceived health status, smartphone use and	Insufficient sleep (i.e. < 8 h) was directly related to suicidal ideation (β = -.10, p<0.001), after controlling for other risk factors. The relationship between sleep and suicidal ideation was mediated by symptoms of depression (β = -.06, p<0.001).

					caffeine consumption.	
Roane et al. (2008) QA Score: 5	4494 adolescents aged 12-18 Mage=15.8, 52.4% female US: Add Health (school and home-based survey)	Cross-sectional	Insomnia symptoms – defined as trouble falling asleep or staying asleep almost every day or every day) Assessment period: past year	Suicidal ideation and attempts Single items (e.g. Have you thought about suicide in the past year?) Time period: past year	Sex and depression	Insomnia symptoms were associated with suicidal ideation and attempts in the univariate analysis. Within the adjusted model, insomnia symptoms were related to suicidal ideation, but not attempts (AOR: 2.10). Follow up analysis indicated that females with insomnia were more likely to have attempted suicide than females without insomnia symptoms. However, insomnia was not a significant risk factor for males.
Roberts et al. (2001) QA Score: 4	5,423 adolescents aged 10-17 Mage: NA, 47.7% females US: school-based study	Cross-sectional	Insomnia (trouble falling asleep, staying asleep or waking up too early almost every day for the past two weeks) and hypersomnia (sleeping too much almost every day for the past two weeks) (DSD)	Suicidal ideation Total score of 4 items from DSD (e.g. Thought more than usual about death or dying," "Wished you were dead," "Thought about suicide or killing yourself," and "Made a plan to kill yourself.".)	Sex, age, socioeconomic status and psychological, interpersonal and somatic dysfunction	Both insomnia (AOR: 1.58) and hypersomnia (AOR: 1.46) were associated with increased risk of suicidal ideation during adolescence. Young people experiencing both insomnia and hypersomnia were more likely (AOR: 3.62) to experience suicidal ideation than those who experienced only one type sleep disturbance. These findings were independent of other indicators of dysfunction including mood disturbance.

			Assessment period: past two weeks	Assessment period: past two weeks		
Russell et al. (2018) QA Score: 6	1,045 adolescents aged 15-17 Mage= 15.3, 52.8% female Scotland: school-based study	Cross-sectional	Insomnia symptoms (SCI) and nightmares (DDNSI) Assessment period: past month	Suicidal ideation Single item (e.g. Have you ever thought about ending your own life?) Assessment period: lifetime history	Depressive symptomology (HADS)	Both insomnia symptoms and nightmares were associated with an increased likelihood of reporting suicidal ideation (independent of depression). The relationship between insomnia and suicidal ideation was fully mediated by perceptions of defeat and entrapment, whereas nightmares were indirectly associated with suicidal ideation through perceptions of defeat and entrapment.
Sami et al. (2018) QA Score: 5	631 adolescents aged 12-18 Mage= 14.9, 56.6% females Israel: school-based study	Cross-sectional	Sleep habits and problems (CASC) Assessment period: NA	Suicidal ideation (PHQ-A) Single item from PHQ-A (e.g. how often have you been bothered by thoughts that you would be better off dead or of hurting yourself in some way) Assessment period: past 2 weeks	Depressive symptoms (PHQ-A)	Sleep disturbances were significantly associated with suicidal ideation (r=0.33, p<0.001). Results of a confirmatory path analysis demonstrated that sleep disturbances are indirectly related to suicidal ideation through depressive symptoms (β=0.5, p<0.01)

| Sarchiapone et al. (2014)

QA Score: 6 | 11778 adolescents Mage=15.0, 65.6% females

11 European countries: SEYLE project | Cross-sectional | Average school day sleep duration (Monday-Friday)

Assessment period: current | Suicidal ideation and attempts (PSS)

Assessment period: past two weeks | Age, sex, emotional symptoms (SDQ), hyperactivity, (SDQ) and anxiety (Z-SAS) | Reduced sleep was associated with increased scores on the suicidal ideation scale (β=-0.08, p<0.001) when controlling for covariates. |
|---|---|---|---|---|---|---|
| Strandheim et al. (2014)

QA Score: 7 | 2399 adolescents aged 13-15 Mage = NA, % females: NA

Norway: Young-HUNT population-based study | Prospective (48 months)

Follow up rate: 80% | Insomnia (defined as difficulties falling asleep, often or almost every night)

Assessment period: Past month | Suicidal ideation

Single item (e.g. Have you had thoughts about taking your own life?)

Assessment period: Lifetime | Age, sex, anxiety (SCL-5), depressive symptoms (SCL-5), attention problems, conduct problems, pain/ tension problems, physical activity, number alcohol intoxications and current smoking status | In the univariate age-adjusted models insomnia symptoms more than doubled (AOR: 2.30) the odds for suicidal thoughts at follow up in both males and females. However, within the multivariate analysis, controlling for a range of physical and mental health problems, insomnia was no longer associated with suicidal thoughts. |
| Tseng et al. (2019)

QA Score: 5 | 746 adolescents aged 10-14 Mage=NA, 53.2% female | Cross-sectional | Sleep duration (Chinese version PSQI (CSPQI), sleep quality (CPSQI) and | Suicidal ideation

Single item(e.g. Have you had suicidal ideation in the previous | Depression (CES-D) and perceived stress (PSS) | Suspected insomnia (based on PSQI score) was associated with an increased risk of suicidal ideation. However, when controlling for depression and perceived stress this |

	Taiwan: school-based study		sleep apnoea (ESS>6, and Q5c from the CPSQI (i.e. trouble sleeping due to difficulties breathing) Assessment period: past month	week) Assessment period: past week		relationship became non-significant. This was also true for sleep quality and short sleep duration (<6 hours). Suspected sleep apnoea (using daytime sleepiness as a screening criterion) was independently associated with suicidal ideation (AOR: 2.25).
Verkooijen et al. (2018) QA Score: 3	16,781 adolescents aged 12-18 Mage: 14.5, 49.5% females Netherlands: school-based study	Cross-sectional	Sleep disturbances (In the past 4 weeks, how often did you experience trouble sleeping?" - never, almost never, sometimes, often, or very often) Assessment period: past month	Suicidal ideation and suicide attempts Single items (e.g. In the previous year, have you seriously considered ending your own life?) Assessment period: past year	Age, sex, level of education, school and grade	Sleep disturbances were associated with suicide ideation (AOR: 3.90) and suicide attempt (AOR: 4.14). Sex moderated the relationship between sleep and suicide attempts, such that the relationship is more pronounced for girls (AOR: 5.71) than boys (AOR: 2.32).
Whitmore et al. (2019) QA Score: 4	12,974 adolescents aged 14-18 Mage: NA,	Cross-sectional	Self-reported school-night sleep duration – categorical	Suicidal ideation Single item: NA	Sex, ethnicity, grade level, bullying (in school and	Sleep durations of 4–5 (AOR: 1.81) hours per night were associated with increased risk of suicide ideation, as

Study	Sample	Design	Sleep measure	Outcome	Covariates	Findings
	50.3% females US: YRBS (2015)		response (e.g. ≤ 4 hours to 5 hours, (2) 6 to 7 hours, and (3) 8 hours or more Assessment period: current	Assessment period: NA	cyber), sexual orientation, student-perceived weight, screen time and depressive state(Feeling so sad/ hopeless nearly every day for 2 weeks or more such that their usual activities stopped)	compared to teens sleeping the recommended 8 hours or more. When compared to optimal sleep duration, sleeping for 6-7 hours per night is only associated with increased risk of experiencing suicidal ideation (AOR: 1.41) in students that do not report depressive symptomology.
Winsler et al. (2015) QA Score: 5	27,939 adolescents aged 13-18 Mage: NA, 51.2% females US: Fairfax County Youth Survey school-based survey	Cross-sectional	Self-reported average school night sleep duration – categorical response (e.g. ≤ 4 hours, 5 h, 6 h, 7 h, 8 h, 9 h, and ≥10 Assessment period: current	Suicidal ideation and suicide attempts Single items (e.g. During the past 12 months, did you ever actually attempt suicide?) Assessment period: past year	Sex, living arrangements, ethnicity and school level and hopelessness (e.g. feel so sad/hopeless almost every day for 2 weeks or more that you stopped doing some usual activities)	One hour less sleep can make a significant difference in terms of risk of suicidal ideation and attempts. For each hour less of weekday sleep there was a significant increase in the likelihood of suicidal ideation (AOR: 1.21) and suicide attempts (AOR: 1.26). These relationships were moderated by sex such that the relationships were stronger in males (although present for both groups).
Wong & Brower (2012)	6504 adolescents	Prospective (12 months)	Frequency of trouble falling	Suicidal thoughts and attempts.	Age, sex, school grade,	Sleep problems (trouble falling asleep or staying asleep) at

QA Score: 7	Mage1: 15.99, % females: NA Mage2: 16.02, % females: NA US: Add Health (school and home-based survey)	Follow up rate: NA	asleep or staying asleep in the past 12 months – categorical response (a few times, once a week, almost every day, or every day) Assessment period: past year	Single items (e.g. during the past 12 months, how many times did you actually attempt suicide?) Assessment period: Past year	poverty, depression (CES-D), alcohol problems, illicit drug use and chronic health problems	Wave 1 were significantly associated with suicide thoughts and attempts at Waves 1 and 2. In multivariate analyses (controlling for suicidal thoughts at Wave 1, depression, alcohol problems, illicit drug use, sex, age, and chronic health problems) sleep problems at baseline predicted suicidal thoughts (AOR: 1.20) and suicide attempts (AOR: 1.22) at the subsequent wave.
Wong et al. (2011) QA Score: 8	392 adolescents aged 12-14 (Wave 1) and 15-17 (Wave 2) Mage1: NA Mage2: NA 28.6% female US: Michigan Longitudinal Study (high risk sample – children of alcoholic parents)	Prospective (3 years) Follow up rate: ~85%	Sleep problems at age 12-14 (trouble sleeping, having nightmares and being overtired (YSR)) Having trouble sleeping was employed as the measure for insomnia.	Suicidal thoughts and self-harm (with and without suicidal intent (YSR)) Single items (e.g. I think about killing myself; I deliberately try to harm or kill myself) Assessment period: past 6 months	Sex, age, parental alcoholism, parental suicidal thoughts, prior suicidal thoughts and self-harm, depressive symptoms at baseline (YSR), aggressive behaviours, alcohol and drug related problems	Having trouble sleeping at 12 - 14 significantly predicted suicidal thoughts (AOR: 2.41) and self-harm behaviours (AOR: 4.10) at ages 15 -17. Depressive symptoms, nightmares and being overtired, at ages 12 -14, were not significant predictors of suicidal ideation or attempts.

			Assessment period: past 6 months		(Drinking and other Drug Use History – Youth Version)	
Wong et al. (2016) QA Score: 6	10,123 adolescents aged 13-18 Mage: NA, % females: NA US: National Comorbidity Survey – Adolescent Supplement	Cross-sectional	Insomnia symptoms (DIS, DMS, and/or EMA) lasting two weeks or longer in the past 12 months Assessment period: past year	Suicidal ideation, plans and attempts Single items (e.g. In the past 12 months, have you seriously thought about killing yourself?) Assessment period: past year	Age, sex, ethnicity, education, parents poverty, substance use, mood and anxiety disorders (WHO CIDI), and chronic health problems that may impact on sleep	In the bivariate analysis, all sleep variables were associated with suicidal thoughts, plans and attempts. When adjusting for covariates, problems falling asleep were associated with suicidal thoughts (AOR: 1.65) and plans (AOR: 2.21) in the past 12 months, while problems staying asleep were associated with suicidal thoughts (OR: 1.81) in the past year. Difficulty falling asleep and staying asleep were also associated with lifetime suicidal thoughts, plans and attempts. Having trouble falling sleeping or staying asleep had both direct and indirect relationships (via substance use, mood and anxiety disorders) on suicidal behaviour.

Yen et al. (2010) QA Score: 6	8319 adolescents aged: 12-18 Mage: NA, 49.3% females Taiwan: school-based study	Cross-sectional	Average sleep duration each night in the last month (below 15th percentile (short sleepers), between 15th and 85th percentile (average sleepers) and over 85th percentile (long sleepers)) Assessment period: past month	Suicidality (suicidal ideation and attempts examined together) K-SADS-E Assessment period: past year	Sex, age, residential background, parental and maternal education level and depression (CES-D)	After controlling for depression and sociodemographic variables, young people reporting a short sleep duration are at increased risk of suicidality (AOR: 1.34) compared to those with average sleep. However, long sleep duration Is not. There was an interaction between short sleep duration and depression, such that significant associations were found in those who did not report depression (AOR: 1.44), and not those with depression.
Zhang et al. (2017) QA Score: 4	10,123 adolescents aged 13-18 Mage: NA, % females: NA US: population based study (NCS-A)	Cross-sectional	Sleep patterns (weeknight bedtime, weeknight sleep duration, weekend bedtime delay (weekend bedtime-weekday bedtime) and weekend oversleep (weekend sleep duration	Suicidality (thoughts, plans and attempts (WHO CIDI) Assessment period: past year	Age, sex and ethnicity.	Shorter weeknight sleep duration (<7 hours) (AOR: 1.68), greater weekend bedtime delay (>2h) (AOR: 1.92), and long periods of weekend oversleep (>2 hours) (AOR 1.75) were associated) with increased odds of suicidality. An earlier weekday bedtime (<22:00) was shown to be protective in terms of suicidality (AOR: 0.59).

			– weekday sleep duration)) Assessment period: current			
Zschoche et al. (2015) QA Score: 6	93 adolescents aged 14-18 Mage: 15.97, 69.9% females Germany: school-based studies	Cross-sectional	Sleep and sleep related problems (PSQI) Assessment period: past month	Suicidality (ideation and attempts (PSS)) Assessment period: lifetime	Age, sex, type of school, depression (YSR), aggressive behaviour (FEPAA)	There was a significant relationship between insomnia symptoms and suicidality (β=0.02, p<0.02) even after adjusting for confounding variables. There was no significant influence of aggressive behaviour on this relationship. However, depression was a partial mediator of the relationship between sleep problems and suicidality (β=0.39, p<0.02).
Zullo et al. (2017) QA Score: 7	151 adolescents aged 12-17 Mage: 15.05, 82.1% females US: hospital-based study (psychiatric inpatient sample)	Cross-sectional	Insomnia symptoms (ISI) Assessment period: past two weeks	Suicide risk (CHRT-SR) continuous variable in which imminent suicide risk is conceptualised as increasing in severity from suicidal ideation to the formation of a suicide plan) Assessment period: past 24 hours	Age, sex, depressive symptoms (QIDS-A-SR-17) and IPTS variables (thwarted belongingness (TB:INQ) perceived burdensome-ness (PB: INQ) acquired	In bivariate analysis, insomnia symptoms were associated with an increased risk of suicide ideation and plans (r=.34, p<0.01). When all IPTS variables and depressive symptoms were included in the model, insomnia symptoms did not make a unique contribution to adolescent suicide risk (p>0.05). The results of the mediation analysis demonstrated that poor sleep indirectly related to suicide risk

	capability (AC: ACSS-FAD))	via PB and depressive symptoms. Insomnia symptoms were not related to AC.

Notes: NA: Information not available in the article. ACSS-FAD: Acquired Capability for Suicide Scale-Fearlessness About Death. Add Health: The National Longitudinal Study of Adolescent to Adult Health. ADHD: Attention Deficit Hyperactivity Disorder. AHQ: Adolescent Health Questionnaire. AOR: Adjusted Odds Ratio. ASRS: Adult ADHD Self-Report Scale. ASHS: Adolescent Sleep Hygiene Scale. ASWS: Adolescent Sleep Wake Scale. BAASSI: The Brief Assessment of Adolescent Suicide & Self-Injury. BDI: Beck Depression Inventory. BHS: Beck Hopelessness Scale. BISS: Behaviourally Induced Insufficient Sleep Syndrome. CADSS: Chinese Adolescent Daytime Sleepiness Scale. CASC: Child and Adolescent Sleep Checklist. CASE: Child and Adolescent Self-Harm in Europe Study. CBCL: Child Behaviour Checklist. CES-D: Center for Epidemiologic Studies Depression Scale. CHRT-SR: The Concise Health Risk Tracking Self-Report. DBAS-C10: Dysfunctional Beliefs and Attitudes about Sleep-Short version for use with children. DDNSI: Disturbing Dreams and Nightmare Severity Index. DIS: Difficulties Initiating Sleep. DMS. DSD: DSM scale for Depression. Difficulties Maintaining Sleep. DSHI-9r: Deliberate Self-Harm Inventory – 9-item version. DSM-V: The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition. EDI: Eating Disorder Inventory. EMA: Early Morning Awakening. ESS: Epworth Sleepiness Scale. HADS: Hospital Anxiety and Depression Scale. INQ: Interpersonal Needs Questionnaire. ISAS: Inventory of Statements about Self-injury. K-SADS: Kiddie Schedule for Affective Disorders and Schizophrenia for Children. K-SADS-E: Kiddie Schedule for Affective Disorders and Schizophrenia for Children—Epidemiology Version. K-SADS-PL: Kiddie Schedule for Affective Disorders and Schizophrenia for Children - Present and Lifetime Version. MINI-Kid: Mini-International Neuropsychiatric Interview for Children and Adolescents. NCS-A: The National Comorbidity Survey Adolescent Supplement. MFQ: Mood and Feelings Questionnaire. NSSI: Non-suicidal self-injury. OR: Odds Ratio. PHQ-A: PHQ-9 Modified for Adolescents. PSS: Paykel Suicide Scale. PSQI: Pittsburgh Sleep Quality Index. QUIDS-SR-17: Quick Inventory of Depressive Symptomatology in Adolescents. RADS-2: Reynolds Adolescent Depression Scale, 2nd Edition. SCI: Sleep Condition Indicator. SCL-5: Symptom Check List - 5. SDQ: Strengths and Difficulties Questionnaire. SDQ-s: Strengths and Difficulties Questionnaire Short Form. SES: socioeconomic status. SIQ: Suicidal Ideation Questionnaire. SIQ-JR: Suicidal Ideation Questionnaire-Junior. SMFQ: Short Mood and Feelings Questionnaire. SSI: Scale for Suicidal Ideation. WHO CIDI: World Health Organization's Composite International Diagnostic Interview. YRBS: Youth Risk Behaviour Survey. YRBSWB: Web-based Youth Risk Behaviour Survey. YSR: Youth Self-Report. Z-SAS: Zung Self-Rating Anxiety Scale.

*BISS is operationalised by the following criteria: (1) a short sleep duration on weekdays (≤ 7 hr), (2) a long weekend oversleep (≥ 2 hr; weekend sleep duration-weekday sleep duration), (3) severe daytime sleepiness (ESS score ≥ 9), and (4) the absence of significant insomnia.

3.4.2. Study characteristics: Measurement of variables

<u>Sleep disturbances</u>

Across the 56 investigations included in the review, a wide range of sleep-related constructs was examined in association with self-harming and suicidal thoughts and behaviours. There was also considerable variation between studies in terms of the number of sleep parameters assessed. Whilst some investigations focused on one aspect of sleep in isolation, others implemented a more comprehensive assessment of adolescents' sleep. The maximum number of sleep parameters investigated in one study was thirteen, but on average studies included two to three sleep variables (M= 2.41, SD= 2.26). The sleep related constructs assessed within the included studies can be broadly grouped into three categories: 1) global assessments of sleep disturbance, 2) symptoms of sleep disorders or problems, and 3) specific sleep parameters. All sleep variables were assessed exclusively using subjective measures, and no studies were identified that employed objective assessment of sleep parameters. The assessment period of sleep-related constructs ranged from current experience to sleep in the past year.

Global assessment of sleep disturbance. Fifteen studies included global assessments of sleep disturbance. Most of these investigations implemented single item measures of non-specific sleep problems. These brief measures asked young people about their overall subjective sleep quality, and if they had experienced poor sleep or trouble sleeping. Five studies (Bandel & Brausch, 2020; Guo et al., 2014; Kaplan et al., 2014; Sami, Danielle, Lihi, & Elena, 2018; Tseng et al., 2019) within this category also implemented more detailed measures of sleep quality including the Pittsburgh Sleep Quality Index (Buysse, Reynolds, Monk, Berman, & Kupfer,

1989), Adolescent Sleep Wake Scale (LeBourgeois, Giannotti, Cortesi, Wolfson, & Harsh, 2005) and the Child and Adolescent Sleep Checklist (Oka et al., 2009). These multi-item measures determine an individual's global sleep quality score by evaluating different aspects of sleep disturbance.

Symptoms of sleep disorders or problems. Twenty-three studies investigated symptoms of sleep disorders or problems. The majority of this research focused on insomnia and nightmares, whilst others considered sleep terrors, sleep walking, hypersomnia and sleep apnoea. There was substantial heterogeneity in the assessment of insomnia across studies (n=17), with eleven different operationalisations and measures being employed. The majority of researchers (n=11) employed single items to assess for the presence of difficulties initiating sleep (DIS), difficulties maintaining sleep (DMS), and early morning awakening (EMA) that characterise insomnia (Blank et al., 2015; Goldstein, Bridge, & Brent, 2008; Liu, 2004; Liu, Chen, Bo, Fan, & Jia, 2017; Liu et al., 2018; McGlinchey, et al., 2017; Nrugham, Larsson, & Sund, 2008; Roane & Taylor, 2008; Roberts, Roberts, & Chen, 2001; Wong et al., 2016; Wong et al., 2011). Given that a diagnosis of insomnia requires that symptoms occur frequently throughout the week, and persist over time, some studies (n=5) went beyond simply asking about the presence of these symptoms, and included questions related to the frequency and severity of these symptoms (Blank et al., 2015; Liu et al., 2018; Roane & Taylor, 2008; Roberts et al., 2001; Wong et al., 2016). However, across these investigations, there was further variation in terms of the threshold criteria for clinically significant insomnia symptoms. One study (Hysing et al., 2015) defined insomnia in line with published quantitative criteria based on the DSM-V, and four studies employed standardised measures of insomnia (Sleep Condition Indicator (Espie et al., 2014), Insomnia

Severity Index (Morin, Belleville, Bélanger, & Ivers, 2011) and PSQI (Buysse et al., 1989), which have been validated in youth samples (Bandel & Brausch, 2020; Russell et al., 2018; Zschoche & Schlarb, 2015; Zullo et al., 2017).

Eight studies (Choquet & Menke, 1990; Jia, Li, Han, & Bo, 2016; Kaplan et al., 2014; Koyawala, Stevens, McBee-Strayer, Cannon, & Bridge, 2015; Liu, 2004; Liu et al., 2017; Russell et al., 2018; Wong et al., 2011) investigated nightmares and considered the experience, frequency and impact of these emotionally distressing and frightening dreams in young people. A single investigation (Koyawala et al., 2015) assessed parent reported nightmares, whilst two others (Kaplan et al., 2014; Russell et al., 2018) employed the Disturbing Dreams and Nightmare Severity Index (Krakow et al., 2002).This is a multi-item measure which requests information about the frequency and severity of nightmares and provides a threshold for determining whether nightmares are considered to be clinically salient. Hypersomnia was examined within four studies (Goldstein et al., 2008; McGlinchey et al., 2017; Nrugham et al., 2008; Roberts et al., 2001). Three employed the K-SADS clinical interview (Kaufman et al., 1997), whilst the other (Roberts et al., 2001) applied the DSM Scale for Depression (Roberts, Roberts, & Chen, 1997). One study investigated sleep terrors and sleep walking (Gau & Soong, 1999), and another (Tseng et al., 2019) examined sleep apnoea (determined on the basis of the Epworth Sleepiness Scale (Johns, 1991) and one item from the PSQI).

Specific sleep parameters. Thirty-four studies examined the relationship between specific sleep parameters using subjective self-report measures. Twenty-six specific sleep variables were assessed and these included measures of sleep duration, sleep continuity (e.g., how long it takes to fall asleep, how long awakening lasts during the night), and sleep-timing (e.g., bedtime, rise time, irregularity between

weekday and weekend sleep). Linked to sleep timing, five studies (Gau et al., 2007;

Goldstein et al., 2008; Lee, Cho, Cho, & Kim, 2012; McGlinchey et al., 2017;

Nrugham et al., 2008) investigated disturbances in circadian aspects of sleep (i.e.,

when sleep and wake fall within the 24-hour rhythm of daily life). These included

circadian reversal (i.e., sleeping during the day and being awake through the night)

and Morningness-Eveningness (i.e., an individual's preference for the timing of their

sleep and wake). Some studies (n=10) assessed adolescents' level of daytime

sleepiness and whether they felt satisfied and rested following their sleep (Choquet

& Menke, 1990; Gangwisch et al., 2010; Oh, & Suk, 2017; Kim, Kim, Kwon, & Kim,

2016; Liu et al., 2017; Liu et al., 2018; McGlinchey et al., 2017; Nrugham et al.,

2008; Park, Yoo, & Kim, 2013; Wong et al., 2011). One investigation (Kaplan et al.,

2014) examined sleep hygiene and sleep-related cognitions in clinical sample of

adolescents using validated measures. There was considerable variation in the

assessment of sleep duration across studies. Whilst some researchers asked about

average sleep duration in general (n=7), others distinguished between sleep on

weekdays and weekends (n=17). This is important as sleep on school nights is

governed by school start times, whilst young people are largely free to choose when

they sleep (and how long for) at the weekend. Moreover, studies differed in relation

to the sleep reference categories that were chosen to indicate optimal sleep within

analyses. These ranged from six to nine hours of sleep.

Suicidal and self-harming thoughts and behaviours

Investigations included a range of suicide and self-harm related outcome

measures, and assessment periods of these measures ranged from current to

lifetime experience of suicidal and self-harming thoughts and behaviour. To ensure

clarity in the interpretation of the results, presented in the review, the terminology

employed is consistent with that specified by the original authors. The majority of studies examined suicidal ideation (i.e., thoughts of taking one's own life) (n=39) and most assessed young people's experience of suicidal thoughts using single item measures that clearly specified the presence of suicidal intent. Five studies (Kang et al., 2014; Kaplan et al., 2014; Lee et al., 2012; McGlinchey et al., 2017; Zullo et al., 2017) investigated suicidal ideation by employing multi-item measures that have demonstrated excellent psychometric properties in adolescent samples (Suicidal Ideation Questionnaire (Reynolds, 1987)), Suicidal Ideation Questionnaire – Junior (Reynolds, 1990), Scale for Suicidal Ideation (Beck, Kovacs, & Weissman, 1979) and Concise Health Risk Tracking – Self Report (Trivedi et al., 2011)).

Almost all studies assessing adolescents' experience of suicide attempts (i.e., self-harming behaviours specifically associated with suicidal intent) (n=22) employed single items, with the exception of three (Gau & Soong, 1999; Koyawala et al., 2015; Nrugham et al., 2008) that utilised more detailed measures (Columbia Suicide History Form (Mann et al., 1992) and the K-SADS clinical interview (Kaufman et al., 1997). Further, one study investigated sleep difficulties preceding death in a sample of adolescents who died by suicide as compared with a matched sample of community control adolescents (Goldstein et al., 2008). Some studies (n=8) looked at suicide risk more broadly and did not differentiate between suicidal ideation and suicide attempts. Instead, these investigations referred to "suicidality", a catch-all term which encompassed a more general assessment of suicide related thoughts and behaviours. Four studies assessed suicidality using items taken from diagnostic interviews (WHO-WMH-CIDI (Merikangas, Avenevoli, Costello, Koretz, & Kessler, 2009), MINI-KID (Sheehan et al., 1998) and K-SADS), two employed the Paykel Suicide Scale (Paykel, Myers, Lindenthal, & Tanner, 1974), one utilised single item

measures (Gau et al., 2007), and another study determined suicidality based on the young person's hospital admission following suicidal behaviour. In the latter case, the authors defined suicidal behaviour as any thoughts, plans and/or attempts (Borschmann, Stark, Prakash, & Sawyer, 2018).

As highlighted, the vast majority of studies focused on thoughts and behaviours that were associated with suicidal intent (n=52). However, four studies conceptualised self-harm as non-suicidal self-injury (NSSI, defined as the deliberate destruction of one's own body tissue in the absence of suicidal intent). Assessment of NSSI differed across studies, but all clearly specified an absence of suicide intent within the items utilised. Two investigations (Bandel & Brausch, 2020; Lundh et al., 2013) measured adolescents' histories of self-injury by requesting that they indicate which behaviours they had previously engaged in from a list of methods of self-harm (Inventory of Statements about Self-Injury (Klonsky & Glenn, 2009) and Deliberate Self-Harm Inventory (Gratz, 2001). Information regarding the severity of NSSI was also gathered using the ISAS. The remaining studies evaluated NSSI utilising single items (Liu et al., 2017; McGlinchey et al., 2017).

Five studies examined self-harm behaviour regardless of underlying motivations or intent (Blank et al., 2015; Hysing et al., 2015; Kang et al., 2014; Matamura et al., 2014; Wong et al., 2011). Four of these investigations employed single items, whilst the other assessed self-harm using questions from the Child and Adolescent Self-Harm in Europe (CASE) study (Hysing et al., 2015). These questions have been employed in studies internationally, provide young people and researchers with a clear definition of self-harm, and afford researchers the opportunity to gather more detailed information about self-harm by inviting young people to provide a description of the act and the frequency with which they have

engaged in self-harm behaviour. No studies examined the relationship between sleep-related constructs and self-harm thoughts more broadly (i.e. irrespective of motivation).

3.4.3. Methodological quality of studies

Quality scores ranged from two to eight (M=4.74). Thirty-six were rated as low quality, eleven were rated as moderate quality, and nine were rated as high quality, indicating that most of the evidence within this field is of low quality. The vast majority of research relies on cross-sectional designs, which prevent the assessment of temporal precedence and limits inferences regarding causality. A 2015 methodological review highlighted the frequent use of single item measures of sleep, as well as self-harming and suicidal related outcomes, within this area of research (Bernert, Kim, Iwata, & Perlis, 2015). This also applies to the studies included in this review since many studies employed brief, non-standardised, and non-validated measures that do not assess the full range of symptoms of sleep or suicide and self-harm risk. This limits the validity and generalisability of findings, and prevents a more nuanced understanding of this relationship.

Numerous studies (n=30) assessed sleep, self-harm, and suicide related outcomes as part of broader adolescent health surveys. As a result, these studies were not conducted with the specific aim of examining this relationship, and these articles tend to report secondary analysis of original data sets. Whilst the use of secondary data is associated with a range of benefits, measures within comprehensive health surveys tend to be succinct. Here, the brief items used to assess broad sleep disturbance do not provide information as to what specific aspects of sleep are important in relation to self-harm. However, four studies did

assess global sleep quality using detailed measures that are frequently employed within the sleep literature and have been validated in adolescent populations (Bandel & Brausch, 2020; Guo et al., 2014; Kaplan et al., 2014; Tseng et al., 2019). The vast majority of studies assessed suicidal ideation and attempts using single item measures. Whilst this is commonplace in suicide research, it represents a widespread limitation within the literature, as single item measures fail to capture the breadth of the suicide risk construct (e.g., severity and frequency) and can lead to misclassification in research settings (Millner, Lee, & Nock, 2015). However, some investigations (n=8) did use multi-item validated measures to assess suicidal ideation, suicide attempts and "suicidality", and detailed checklists were employed in two of the investigations evaluating NSSI (Bandel & Brausch, 2020; Lundh et al., 2013). Further, Hysing et al. (2015) utilised the CASE self-harm questions, which have been employed frequently within the adolescent self-harm literature, and provide detailed information regarding young people's engagement in these behaviours.

The use of non-validated measures was particularly apparent in the assessment of sleep disorders. For example, insomnia symptoms are frequently assessed using single items, which evaluate difficulties initiating sleep, difficulties maintaining sleep, and early morning awakening. Whilst these items do tap into the characteristic symptoms of insomnia, these measures fail to take the multidimensional nature of insomnia into account, and ignore the daytime symptoms that are a key feature of the diagnostic criteria for insomnia. That being said, four studies did employ validated measures of insomnia (Bandel & Brausch, 2020; Russell et al., 2018; Zschoche & Schlarb, 2015; Zullo et al., 2017), and another defined insomnia according to published quantitative research criteria for this sleep

disorder (Hysing et al., 2015). These issues also apply across the assessment of sleep terrors, sleep walking, hypersomnia, and sleep apnoea. Only four investigations included within the review employed validated measures throughout data collection (i.e., for both sleep and self-harm or suicide related constructs) (Bandel & Brausch, 2020; Kaplan et al., 2014; Zschoche & Schlarb, 2015; Zullo et al., 2017).

Given that sleep problems predict the onset of depression (Baglioni et al., 2011) and depression is a strong predictor of suicidality and self-harm (Rihmer, Dome, O'Connor, & Pirkis, 2016), it is important to adjust for the presence of depressive symptoms in order to ascertain the independent contribution of sleep. Whilst most studies did adjust for depressive symptoms, seventeen studies did not. There was significant heterogeneity in the assessment of depressive symptoms with measures ranging from single item measures of sadness/hopelessness, to validated questionnaire measures and clinical diagnostic interviews. Researchers statistically controlled for symptoms of depression in a number of different ways across investigations including mediation, moderation, and the inclusion of depressive symptoms as a covariate. Anxiety is similarly associated with both sleep problems (McMakin & Alfano, 2015) and self-harm in young people (O'Connor, Rasmussen, & Hawton, 2010). However, only four studies controlled for anxious symptomology (Blank et al., 2015; Sarchiapone et al., 2014; Strandheim et al., 2014; Wong et al., 2016). Almost all papers met the criteria for appropriate statistical analyses and reporting.

Is poor sleep associated with self-harming and suicidal thoughts and behaviours in adolescents?

<u>Suicidal ideation as an outcome</u>

1. Global sleep disturbance

Ten studies investigated the relationship between global sleep disturbance and suicidal ideation. The experience of being unable to sleep, not sleeping well, having trouble sleeping, and reporting overall difficulties with sleep, were all associated with risk of suicidal ideation (Altangerel, Liou, & Yeh, 2014; Alves Junior, Nunes, de Andrade Gonçalves, & Silva, 2016; Choquet, Kovess, & Poutignat, 1993; Guo et al., 2014; Verkooijen et al., 2018). It is not clear whether these findings were independent of the severity of depressive symptoms, as these investigations did not adjust for depression within their analyses. Differences in results emerge when comparing the results of investigations that employ single item measures of sleep quality vs. global scores from multi-item questionnaires. One study which assessed sleep problems (defined as trouble falling asleep or staying asleep) using a single item demonstrated that poor sleep was an independent predictor of suicidal ideation within a model adjusting for a range of demographic, mental health, and health risk behaviour variables (Wong & Brower, 2012). On the other hand, results from investigations which utilised multi-item, validated measures of sleep quality have highlighted that the relationship between poor sleep quality and suicidal thoughts are independent of age and gender, but not depressive symptomology or perception of stress (Kaplan et al., 2014; Sami et al., 2018; Tseng et al., 2019). Follow-up analysis within one investigation suggested that sleep problems may be indirectly related to suicidal ideation via increased depressive symptoms (Sami et al.,

2018). It is therefore important to bear in mind that mixed results may have emerged here due to variation in the assessment of sleep quality and depression.

2. Symptoms of sleep disorders and problems

Eleven studies investigated the relationships between insomnia symptoms and suicidal ideation. Within these studies assessment ranged from single item measures of the presence of symptoms (e.g., difficulties initiating sleep (DIS), difficulties maintaining sleep (DMS) and early morning awakening (EMA)), to standardised and validated measures developed from the diagnostic criteria for insomnia. Irrespective of the measures used to assess insomnia, in unadjusted models, symptoms were associated with elevated risk of suicidal ideation across all studies. However, when examining relationships within the context of adjusted models, mixed results again emerged.

Where single items assessed the presence of insomnia symptoms, two cross-sectional studies differed in their results. Liu et al. (2004) reported that, in a community sample of adolescents, all night-time insomnia symptoms (i.e. DIS, DMS and EMA) were associated with suicidal ideation in the univariate analysis, but findings did not persist when controlling for both demographic variables and depressive symptoms. However, McGlinchey et al., 2017 highlighted that waking up in the morning and not being able to get back to sleep (i.e., EMA), was independently associated with suicidal ideation in a clinical sample of young people, but DIS and DMS were not (within the adjusted model). In their prospective investigation, Wong, Brower & Zucker (2011), note that insomnia (operationalised by the authors as trouble falling asleep) at 12-14 years old predicted subsequent experience of suicidal thoughts (at age 15-17). This association remained significant

within the adjusted model, which controlled for previous suicidal thoughts, depressive symptoms, aggressive behaviours, substance related problems, overtiredness, and nightmares.

Five studies (Liu et al., 2018; Roane & Taylor, 2008; Roberts et al., 2001; Strandheim et al., 2014; Wong et al., 2016) assessed insomnia using single items that tapped into both the experience and the frequency of symptoms. There was heterogeneity in the frequency criteria employed to determine the presence or absence of insomnia. Two cross-sectional investigations (Roberts et al., 2001; Wong et al., 2016) found that experiencing insomnia symptoms each day/almost every day for the past two weeks was associated with increased risk of suicidal ideation, when controlling for demographic variables, mood disturbance, depression, and anxiety. On the other hand, difficulties falling asleep almost every night for the past month was related to suicidal ideation in univariate but not multivariate analysis (Strandheim et al., 2014). Further, experiencing insomnia symptoms at least three times a week in the past month did not predict the future onset of suicidal thoughts when controlling for daytime sleepiness, sleep duration, snoring, and depressive symptomology (Liu et al., 2018).

Tseng et al. (2018) noted that young people with suspected insomnia (as assessed by the PSQI) were over four times more likely to report suicidal ideation in the past week. However, when adjusting for depressive symptoms and stress, this relationship was no longer significant. Three other studies that utilised validated measures of insomnia symptoms set out to examine potential intermediate psychological processes linking insomnia symptoms and suicidal ideation. Russell, Rasmussen & Hunter (2018) investigated the relationship between insomnia symptoms and lifetime suicidal ideation (O'Connor & Kirtley, 2018). The authors

noted that whilst this relationship was independent of depressive symptomology, the inclusion of perceptions of defeat and entrapment negated this relationship, highlighting the role of these constructs as mediators. Zullo et al. (2018) highlighted that the association between insomnia symptoms and suicide risk disappeared within the adjusted analysis, which controlled for depressive symptomology, thwarted belongingness, perceived burdensomeness and acquired capability) (Joiner, 2005; Van Orden et al., 2010). Follow up analyses demonstrated that poor sleep was indirectly related to suicide risk via perceived burdensomeness (i.e. the perception of being a burden or a liability to others) and depressive symptomology within a clinical sample. Finally, Zshcoche et al. (2014) noted that aggressive behaviour did not mediate the relationship between insomnia symptom and suicidal ideation.

Where nightmares are concerned, cross-sectional investigations have demonstrated that the experience of nightmares, nightmare frequency, and the impact of nightmares were associated with suicidal ideation (Choquet & Menke, 1990; Jia et al., 2016; Liu, 2004). Scores on the Disturbing Dreams and Nightmare Severity Index were positively correlated with suicidal ideation scores when adjusting for age, sex and depression (Kaplan et al., 2014; Russell et al., 2018). However, nightmares at aged 12-14 years old did not predict suicidal ideation by age 15-17 within the adjusted model (which controlled for previous suicidal thoughts, mental health variables and the presence of insomnia) (Wong et al., 2011).

Only two studies have examined hypersomnia as a correlate of suicidal ideation and results were inconsistent. One investigation conducted within a clinical sample demonstrated that hypersomnia was not associated with an increased score on the Suicidal Ideation Questionnaire when adjusting for confounding variables (McGlinchey et al., 2017). Conversely, results from one school-based study noted

that hypersomnia was linked to increased risk of suicidal thoughts, and that young people experiencing both insomnia and hypersomnia were at increased risk (Roberts et al., 2001). These findings were independent of mood disturbance. Adolescents experiencing symptoms of other sleep disorders, including sleep terrors, sleep walking (Gau & Suen Soong, 1999) and sleep apnoea (Tseng et al., 2019) have also been shown to demonstrate increased risk of suicidal thoughts.

3. Specific sleep parameters

The vast majority of studies investigating specific sleep parameters examined sleep duration in relation to suicidal ideation. All studies investigating this relationship demonstrated that, within univariate analyses, short school-night sleep duration was significant associated with increased risk for suicidal ideation. Sleeping for less than 8 hours on school nights was significantly associated with increased risk of suicidal ideation when controlling for age and sex. However, inconsistent results emerge when depressive symptoms are accounted for. Eight studies (Fitzgerald, Messias, & Buysse, 2011; Jia et al., 2016; Kang et al., 2014; Kim et al., 2016; Park et al., 2013; Park & Kim, 2017; Park, Yang, & Kim, 2019; Sarchiapone et al., 2014; Winsler, Deutsch, Vorona, Payne, & Szklo-Coxe, 2015) reported that the relationship between short sleep and suicidal thoughts was independent of depression, whilst five suggested that this was not the case (Koyawala et al., 2015; Lee et al., 2012; Liu, 2004; Liu et al., 2018; Tseng et al., 2019). It is not clear what is responsible for these mixed results. One study demonstrated that depressive symptoms moderated this link, such that the relationship between short sleep duration and thinking about suicide was only apparent in those without depression (Guo et al., 2017).

Two studies revealed that individuals who perceived themselves to not be getting enough sleep were also at greater risk of suicidal ideation (Im et al., 2017; Kim et al., 2016). Further, one investigation established that short sleep duration and the perception of not getting enough sleep mediated the relationship between later parental set bedtime (after 10pm) and heightened risk of suicidal thoughts (Gangwisch et al., 2010). Longer weekend oversleep (sleeping for an increased duration) and larger weekend rise time delay (waking up and rising later) were associated with increased risk of suicidal ideation (Lee et al., 2012). These effects were independent of depression. The relationship between weekend bed-time delay (going to bed later) and suicidal thoughts was negated within the adjusted analyses (Lee et al., 2012). One study demonstrated that dysfunctional sleep related cognitions were also related to an increased risk of suicidal thoughts. However, adolescent sleep hygiene (practices and habits) was not (Kaplan et al., 2014).

In terms of prospective research, one study demonstrated that daytime sleepiness was associated with subsequent suicidal thoughts (Liu et al., 2018), whilst another highlighted that being overtired was not (Wong et al., 2011). To date, research focusing on circadian timing or disturbances is sparse. Cross-sectional research notes that demonstrating a preference for later bedtimes and rise times (i.e., eveningness) predicted a higher score on the Scale for Suicidal Ideation (Lee et al., 2012). However, another investigation conducted in a clinical sample of adolescents noted that circadian reversal (sleeping during the day and being awake at night) did not outperform depressive symptoms (McGlinchey et al., 2017).

Suicidal behaviour as an outcome

1. Global assessments of sleep disturbances

The experience of being unable to sleep, not sleeping well or having trouble sleeping was related to increased likelihood of having attempted suicide (Altangerel et al., 2014; Alves Junior et al., 2016; Verkooijen et al., 2018). Further, parents of young people with a history of suicide attempts, when compared to parents of adolescents with no history of suicidal thoughts or behaviours, reported that their child had more sleep difficulties. In terms of prospective research, one study established that sleep problems (defined as trouble falling asleep or staying asleep) at baseline, were associated with an elevated risk of endorsing a subsequent suicide attempt (when controlling for a range of confounding factors) (Wong & Brower, 2012). One psychological autopsy investigation revealed that overall sleep disturbances were greater preceding death in a sample of adolescents who died by suicide, as compared with overall sleep disturbance in the previous week in a matched sample of community control adolescents (Goldstein et al., 2008). These findings persisted when controlling for the severity of depressive symptoms.

2. Symptoms of sleep disturbance and problems

All investigations demonstrated a relationship between insomnia symptoms and suicide attempts. However, it is not clear whether this link is independent of depressive symptomology. Whilst three studies suggest that the relationship between insomnia symptoms and suicide attempts is negated when adjusting for depressive symptoms (Liu, 2004; Liu et al., 2018; Roane & Taylor, 2008), the results of other investigations contradict this. One investigation suggests that difficulties initiating sleep (Nrugham et al., 2008) contribute to increased risk, whilst another highlights the role of difficulties maintaining sleep (McGlinchey et al., 2017). However, to date, research investigating the role of insomnia subtypes is sparse. Wong et al. (2016) noted that insomnia symptoms were associated with lifetime, but

not past month, history of suicide attempts when controlling for confounding variables. Notably, one investigation highlighted the importance of examining sex differences when exploring this relationship. The link was not significant within the overall sample; however, follow-up analyses demonstrated that the association was significant in girls but not boys (Roane & Taylor, 2008). With regards to suicide death, a case-control study (Goldstein et al., 2008), demonstrated that young people who had died by suicide were more likely to report insomnia when compared to matched community controls. Higher insomnia rates in the case (vs. control) group held after controlling for depressive symptoms.

Research investigating other sleep disorders is scarce. Preliminary findings, based on individual studies, demonstrate that sleep terrors, sleep walking (Gau & Soong, 1999), parent reported nightmares (Koyawala et al., 2015), and hypersomnia were not significantly associated with a heightened risk of suicide attempts (Nrugham et al., 2008). Self-reported frequent nightmares were cross-sectionally associated with an increased likelihood of suicidal behaviour independent of demographic variables and depression (Liu, 2004). However, this finding did not replicate prospectively. Nightmares at ages 12-14 did not significantly predict risk of suicide attempts three years later (Wong et al., 2011). Concerning death by suicide, young people who had taken their own lives demonstrated higher rates of hypersomnia, than community controls. However, this relationship did not persist when controlling for depressive symptoms (Goldstein et al., 2008).

3. Specific sleep parameters

The majority of studies (Fitzgerald et al., 2011; Kim, Park, Lee, & Yoo, 2015; Liu, 2004; Park & Kim, 2017; Winsler et al., 2015) demonstrated that adolescents

reporting short or long sleep duration were at significantly greater risk of reporting suicide attempts. However, some authors (Koyawala et al., 2015; Liu et al., 2018) noted that this relationship was not significant within adjusted models. Some investigations suggest that the relationship between sleep duration and suicide attempts may be moderated by depressive symptoms, such that this relationship is stronger or only significant in adolescents with depression (Guo et al., 2017; Jang, Lee, & Park, 2013). Findings were mixed concerning the influence of non-restorative sleep on risk of suicide attempts, such that it was unclear whether the relationship is independent of depressive symptoms (McGlinchey et al., 2017; Nrugham et al., 2008; Park et al., 2013). One prospective investigation (Liu et al., 2018) noted that increased levels of daytime sleepiness were associated with subsequent suicide attempts (within an adjusted model controlling for insomnia, snoring, and sleep duration). With regards to sleep timing, McGlinchey et al. (2017) reported that circadian reversal was linked to an increased likelihood of engaging in suicidal behaviour within a clinical sample.

Suicidality as an outcome

1. Global sleep disturbance

Studies that assessed suicidality applied a more general assessment, which comprised both suicide-related thoughts and behaviours (i.e., did not distinguish between suicidal ideation, plans, and suicide attempts). Frequency of poor sleep was associated with suicidality (defined as engaging in suicidal thoughts, plans and/or acts in the past month). These findings persisted when controlling for depressive symptomology, but not symptoms of adjustment disorder (Chung et al., 2014). One article, which reported the results of a retrospective audit of young people admitted

to a mental health inpatient facility (as a result of experiencing suicidal thoughts, making a suicide plan, and/or engaging in suicidal behaviours), noted that 75% of these young people reported experiencing difficulties with their sleep prior to admission.

2. Symptoms of sleep disorders and problems

Blank et al. (2015) examined the relationship between insomnia symptoms and suicidality (defined as any engaging in suicidal thoughts, plans and/or attempts in the past year) in a population-based sample of young people. Results of this investigation highlighted that DIS, DMS, and EMA were associated with suicidality, even where young people did not report comorbid mental health problems. However, the authors did note that risk of suicidal thoughts, plans, and/or attempts were greatest for those experiencing both poor sleep and concomitant mental health difficulties such as mood, anxiety, behavioural, and eating disorders. The increased severity of insomnia symptoms within this subgroup is thought to underlie their elevated vulnerability. Another investigation (Zschoche & Schlarb, 2015), which operationalised insomnia using the PSQI, demonstrated that insomnia symptoms were associated with increased suicidality. In this case, suicidality was determined using Paykel's Suicide Scale, which assesses the presence of suicidal ideation and/or attempts during the past 12 months. This relationship was partially mediated by depression. No studies have investigated the role of nightmares, or other sleep disorders, in relation to suicidality.

3. Specific sleep parameters

Short sleep, but not long sleep, has been shown to be associated with an increased risk of suicidality (Sarchiapone et al., 2014; Yen, King, & Tang, 2010;

Zhang et al., 2017). One study noted that depression may moderate the relationship between short sleep and suicidality (defined as a history of suicidal ideation and/or attempts), such that significant associations were found in those who did not report depression. With regards to the timing of sleep, one investigation (Zhang et al., 2017) highlighted that young people reporting a weekend bedtime delay of over two hours, and longer periods of oversleep at the weekend were more likely to indicate a history of suicidality. Further, a weekday bedtime that was earlier than 10pm was shown to offer protection in relation to suicidal thoughts and/or behaviours in the past year. Finally, concerning circadian aspects of sleep, eveningness was associated with an elevated risk of reporting suicidality (defined as engaging in suicidal ideation and/or attempts) relative to those who indicated having a morning or intermediate (i.e. neither morning or evening) preference for the timing of their sleep and waking activities (Gau et al., 2007). This relationship was attenuated, but not negated, when adjusting for adolescent's emotional and behavioural difficulties.

Non-suicidal self-injury as an outcome

1. Global assessments of sleep disturbance

Four studies operationalised self-harm as non-suicidal self-injury. Cross-sectional findings concerning the role of sleep quality were mixed. Bandel & Brausch (2020) demonstrated that adolescents who had engaged in self-harm in the past six months reported poorer sleep quality than those who had not. However, this relationship was no longer significant when depressive symptoms were controlled for within the analysis. Further, poor sleep quality was not associated with the frequency or versatility (defined as the number of methods) of NSSI in that past 6 months. Conversely, Liu et al. (2017) noted that sleep quality, as determined using a single

item, was associated with an increased risk of lifetime NSSI when controlling for a range of important demographic, mental health, psychological, and sleep variables. In an investigation of adolescents presenting to a community clinic for mood disorders, McGlinchey et al. (2017) revealed that young people with a history of NSSI reported significantly more sleep complaints overall than those who had never engaged in these acts. In their prospective analysis, Lundh et al. (2013) demonstrated that the experience of not sleeping well predicted subsequent engagement in NSSI in girls, but not boys.

2. Symptoms of sleep disturbance and problems

Within the studies included in this review, findings concerning the relationship between insomnia and NSSI were mixed. Bandel & Brausch (2020) demonstrated that insomnia symptoms (defined by DSM-V diagnostic criteria) were associated with NSSI engagement in the past six months, and that this relationship persisted when controlling for depression. However, two other investigations (Liu et al., 2017; McGlinchey et al., 2017), conducted in community and clinical samples, revealed that when adjusting for demographic variables and depression, the relationship between insomnia symptoms (defined using single item measures) and lifetime history of NSSI was negated. This was also found to be the case for symptoms of hypersomnia (McGlinchey et al., 2017). To date, only one investigation has examined the relationship between nightmares and risk of NSSI (Liu et al., 2017). This study was cross-sectional in nature, and demonstrated that experiencing frequent nightmares was significantly associated with an increased likelihood of engaging in NSSI. Nightmares outperformed a range of demographic, mental health, psychological and sleep variables in the prediction of NSSI, and were proposed to be an independent risk factor.

3. Specific sleep parameters

Liu and colleagues (2017) investigated the relationship between a range of specific sleep parameters and NSSI. Several sleep variables were associated with increased risk of NSSI including: sleeping less than 6 hours on school nights, sleeping for less than 6 hours at the weekend, the perception of not getting enough sleep, not feeling refreshed upon awakening or not being satisfied with sleep, as well as daytime sleepiness and fatigue. Only short sleep duration and sleep satisfaction were found to be associated NSSI after adjusting for demographic and depressive symptoms. However, these relationships were no longer significant when controlling for other sleep problems.

Self-harm (irrespective of motivation or intent) as an outcomes

1. Global assessments of sleep disturbance

No studies have investigated the relationship between overall sleep quality, or disturbance, and self-harm (assessed irrespective of motivation or intent).

2. Symptoms of sleep disturbance

Three investigations have examined the relationship between insomnia and self-harm. Findings were in conflict to those established in relation to NSSI, such that the link between insomnia symptoms was found to be independent of depressive symptomology (Blank et al., 2015; Hysing et al., 2015). The authors of these articles did note that depressive symptoms do account for some, but not all, of this association. Hysing et al. (2014) also noted that there was a significant dose response relationship between insomnia symptoms and self-harm, such that the prevalence of insomnia was greater in those who engaged in repeat self-harm relative to those who had engaged in self-harm on one occasion only. Employing a

prospective design, Wong and colleagues (2011) demonstrated that insomnia symptoms (operationalised as trouble sleeping) at age 12-14 predicted self-harm (regardless of suicidal intent) three years later. No studies have investigated nightmares, or other sleep disorders, in relation to self-harm more broadly.

3. Specific sleep parameters

To date, three studies have investigated the relationship between sleep duration and self-harm, with conflicting results (Hysing et al., 2015; Kang et al., 2014; Matamura et al., 2014). Kang and colleagues (2014) noted that sleep duration was not associated with self-harm risk within univariate or multivariate models. Conversely, two other investigations (Hysing et al., 2015; Matamura et al., 2014) revealed that adolescents reporting short sleep duration were more likely to report having engaged in self-harm behaviour. Additional analyses highlighted that sleep duration demonstrated a dose-dependent relationship with self-harm frequency, such that young people who had engaged in self-harm on more than one occasion were more likely to report short sleep duration when compared to those who had harmed themselves once (Hysing et al., 2015).

Hysing et al. (2014) have conducted the most detailed cross-sectional investigation of the relationship between sleep problems and self-harm. In a large sample of Norwegian adolescents, taking longer to fall asleep, waking up during the night, weekend catch up sleep, and greater sleep deficiency (defined as the difference between sleep duration and adolescents subjective sleep need) were associated with an increased likelihood of reporting self-harm. These findings were independent of depression, perfectionism, and symptoms of ADHD.

3.5. **Discussion**

Adolescence represents a period of vulnerability for the onset of sleep problems, as well as self-harmful and suicidal thoughts and behaviours. The current review aimed to systematically evaluate, critically appraise, and synthesise the extant literature pertaining to the relationship between sleep related disturbances and risk of suicide and self-harm in young people. Overall, the majority of evidence supports the role of sleep problems in suicidal and self-harming pathways. Further, in examining the quality of the evidence within this field, it has been possible to determine the main strengths and limitations within the literature and to consider priorities for future research. It is important to note that whilst research overall does support the premise that experiencing sleep disruption may increase a young person's vulnerability to suicide and self-harm, some inconsistencies in findings have emerged within the articles presented within the current review. There has been substantial heterogeneity in the operationalisation of key constructs, assessment of variables, as well as in research designs and statistical analyses. This variation may partly account for divergent patterns of results, which complicates understanding regarding this relationship and makes it challenging to compare results across studies.

Global assessment of sleep disturbances is associated with suicidal thoughts, suicide attempts, and non-suicidal self-injury. However, it remains unclear whether these findings are independent of depressive symptoms among cross-sectional investigations. Interestingly, results appear to vary according to the measurement of global sleep disturbances. Scores from more detailed and precise measures of sleep quality are not significantly associated with suicidal thoughts and non-suicidal self-injury when depressive symptoms are accounted for, whilst single item measures of sleep predict risk independent of depressive symptoms. No research has examined

sleep quality in relation to suicide attempts, or self-harm more broadly, using multi-item, validated measures. As such, it was not possible to determine whether this pattern of results applied across all outcomes. With regards to prospective research, findings (Lundh et al., 2013; Wong & Brower, 2012) demonstrated that global sleep disturbances are associated with subsequent non-suicidal self-injury and suicide attempts within adjusted models. However, gender differences emerged in one of these investigations, such that not sleeping well predicted later engagement in NSSI in girls, but not boys (Lundh et al., 2013).

Concerning symptoms of sleep disturbance, most studies have focused on the influence of symptoms of insomnia. Whilst difficulties initiating sleep and maintaining sleep appear to predict self-harming and suicidal thoughts and behaviours among both cross-sectional and prospective investigations, again it is challenging to form conclusions as to whether these findings are independent of depressive symptoms. This is due to opposing findings as well as substantial variation in the measurement of insomnia symptoms. Research regarding nightmares is sparse, but findings do provide preliminary evidence that experiencing frequent frightening and emotionally distressing dreams may be associated with an increased likelihood of suicidal ideation, suicide attempts, and non-suicidal self-injury. Whilst cross-sectional relationships appear to be independent of depressive symptoms, prospective associations do not. No studies have investigated nightmares in relation to self-harm (irrespective of motivation and intent). Hypersomnia, sleep terrors and sleepwalking appear to be associated with suicidal thoughts, but not attempts. However, on the whole research is lacking and these relationships require further investigation. Given that Delayed Sleep Phase Disorder emerges during adolescence, is common in young people, and is associated with significant daytime impairment (Gradisar &

Crowley, 2013), it is surprising that none of the articles included in this review have examined the impact of this circadian timing disorder on self-harm risk.

A wide range of specific sleep parameters has been assessed in relation to vulnerability to self-harming and suicidal thoughts and behaviours. However, the vast majority of these studies have focused on sleep duration. This is unsurprising given that insufficient sleep during adolescence has been highlighted as a transcontinental phenomenon (Gradisar et al., 2011), and short sleep has been linked to a myriad of negative health and behavioural consequences (Shochat et al., 2014). Findings consistently demonstrated that sleep duration is associated with suicide and self-harm risk. Three studies within this review suggest that the relationship between short sleep duration and suicidal thoughts and behaviours may be moderated by depression, such that the association was stronger or only significant in young people who did not report depressive symptomology. Whilst a recent systematic review and meta-analysis suggests depression does not moderate this relationship (Chiu et al., 2018), further investigation using validated measures is required before firm conclusions can be made. Preliminary findings suggest that young people reporting short sleep duration were more likely to engage in self-harm acts (irrespective of motivation or intent), and that insufficient sleep may be associated with the repetition of these behaviours.

Perception of not getting enough sleep, daytime sleepiness, or demonstrating a preference for later bed and rise times were associated with increased risk of suicidal thoughts and behaviour. Further, weekend oversleep, weekend rise delay, and weekend bedtime delay were all associated with suicidal ideation. This pattern of sleep timing is characteristic of Delayed Sleep Phase Disorder and reinforces the need for research investigating the potential role of this sleep disorder as a risk

factor for self-harm thoughts and behaviours. Whilst two investigations examining sleep in relation to non-suicidal self-injury and self-harm (irrespective of motivation) have incorporated a wider range of specific sleep parameters and problems, research of this nature is scarce and replication is necessary. Overall, research employing a broader operationalisation of self-harm is limited. This is surprising given that this definition is favoured in Europe, and that the motivations underlying self-injury and self-poisoning are heterogeneous and often change over time. As such, there is a need for more investigations which include detailed assessment of sleep disturbance and self-harm (irrespective of intent) during adolescence.

It is important to note that whilst sleep disturbances are common during adolescence, not all young people who experience poor sleep will engage in self-harming and suicidal thoughts and behaviours. As a result, there is a need to better understand *how* and *why* sleep disturbance may contribute to the onset and persistence of these thoughts and behaviours during this high-risk developmental period. Research that aims to identify the psychological processes that potentially drive the relationship between sleep and self-harm in young people is in its infancy, such that only three of the included studies set out to do this (Russell et al., 2018; Zschoche & Schlarb, 2015; Zullo et al., 2017). These studies highlight the potential role of key constructs from two of the most prominent models of suicide, The Integrated Motivated Volitional Model of Suicidal Behaviour and The Interpersonal-Psychological Theory of Suicide. Russell et al. (2018) noted that the relationship between sleep disorders (insomnia disorder and nightmare disorder) and suicidal ideation was mediated by perceptions of defeat and entrapment in a community sample of adolescents. Zullo et al. (2018) highlighted the role of depressive symptoms and perceived burdensomeness in driving the relationship between

insomnia and suicidal ideation. Finally, Zschoche et al. (2014) demonstrated that aggressive behaviour did not account for the association between symptoms of insomnia and suicide risk.

To date, all research investigating these theoretically derived pathways have employed cross-sectional research designs, and have focused exclusively on thoughts that are associated with suicidal intent. It is necessary to determine if these findings replicate prospectively, and to self-harm thoughts (irrespective of motivation). This field of investigation will also benefit from integration with theoretical models of sleep disorders. Given that the psychological pathways underlying this relationship are far from established, further investigation is required to determine when and how psychological factors confer risk or resilience in response to, or in conjunction with, sleep disturbance. Future research should examine mediators and moderators of the relationship between sleep, suicide and self-harm, within the context of prominent models of theoretical frameworks (e.g., The Integrated Motivational-Volitional Model of Suicidal Behaviour).

Research consistently demonstrates that more young people will think about self-harm than will engage in self-harmful acts. As a result, contemporary theoretical models emphasise the importance of discovering which risk factors distinguish between people who think about self-harm but do not act on these thoughts, and those who will go on to harm themselves. Research of this nature would help us better understand which factors predict ideation and which are implicated in the translation of thoughts into action. As such, it has been proposed that a "thoughts-to-action" framework guide suicide theory, research, and prevention (Klonsky & May, 2014; O'Connor et al., 2011). None of the studies included in the current review were conducted in line with this guidance, and so it is not yet clear whether sleep

disturbance facilitates the transition between thoughts and actions. Future research should aim to determine if sleep problems distinguish between young people who ideate about suicide or self-harm but do not go on to harm themselves, and those who engage in self-harm or attempt suicide. If this is found to be the case, it will be important to determine which aspects of sleep are important. Contemporary models of suicide and self-harm present the formation of thoughts, and behavioural enactment, as distinct phases in suicidal and self-harming pathways. However, all research examining the psychological mechanisms driving the sleep-suicide link, have focused exclusively on suicidal ideation. Future research should aim to determine whether these psychological pathways link sleep problems and self-harm *behaviour.*

There is a notable lack of qualitative or mixed-methods research investigating within this area of research. Qualitative interviews (Littlewood, Gooding, Kyle, Pratt, & Peters, 2016a) and mixed-method diary studies (Hochard, Ashcroft, Carroll, Heym, & Townsend, 2017) have provided valuable insights into the role of sleep disturbance in self-harm risk within adult samples. However, these findings cannot be directly applied to young people, as adolescence is a developmental period with unique challenges. Future research should aim to employ mixed-method research designs to advance understanding regarding the factors that contribute to sleep disturbance and self-harm thoughts and behaviours in young people. This knowledge has the potential to inform theoretical conceptualisations of this relationship, generate testable hypotheses regarding the pathway from sleep disturbance to suicide and self-harm, and may inform the development of interventions in the future.

3.5.1. Considerations

When interpreting the findings of this review, it is important to consider a number of methodological aspects of the research that has been conducted to date. Firstly, different operationalisations and terminologies were employed across studies in terms of sleep disturbance, suicide, and self-harm. Further, there was substantial variation among investigations with regards to the assessment of sleep related constructs as well as suicidal and self-harming outcomes. There is a lack of standardised definitions employed throughout research in the fields of both sleep and suicide/self-harm research, and as a result, difficulties measuring these variables have long been documented (Silverman, 2016; deZambotti et al., 2018). The ways in which sleep, suicide, and self-harm are operationalised and assessed have a significant impact on prevalence rates that are identified within studies. The meaningful interpretation of results, and consolidation of evidence, relies on the precise specification and assessment of the sleep parameters and outcomes being measured. For these reasons, the field requires consistency and it is necessary to determine best practice and implement standardisation of measurement tools when measuring similar constructs. This provides the opportunity to determine which sleep parameters and problems, if any, offer predictive utility in relation to self-harming and suicidal thoughts and behaviours. Further, it will provide valuable understanding as to whether findings converge or diverge across outcome variables (i.e. ideation vs. action).

Secondly, studies were predominantly cross-sectional in design, and with that come a number of limitations. Whilst some prospective studies have been included within this review, they are narrow in focus and fail to take the multidimensionality of sleep health into consideration. Future research is required, which provides a more

comprehensive assessment of sleep in relation to more detailed measures of suicide and self-harm related outcomes. Such studies should specifically include items regarding the frequency and severity of any thoughts and behaviours. This will afford researchers the opportunity to develop a more fine-grained understanding of the relationship between various sleep dimensions and different aspects of suicide and self-harm. For example, it is not yet clear whether sleep profiles differ in young who have engaged in first time and repeat self-harm. Further, given that some of the most dynamic changes in sleep and circadian timing within the lifespan occur during adolescence, it is surprising that so few studies assessed circadian aspects of sleep, and none has done so in relation to self-harm more broadly. Future research should include measures of chronotype (preference for the timing of sleep and waking) and social jetlag.

Thirdly, it is important to note that a significant proportion of studies, which have investigated sleep in relation to suicide and self-harm risk, have assessed predictor and outcomes variables using disjointed time-periods. For example, most studies examined past month sleep in relation to past year or lifetime suicidal and self-harming thoughts and behaviours. Whilst this may provide information about the role of sleep disturbance and vulnerability to suicide and self-harm overall, it is possible that sleep patterns and disturbances at the time of assessment may differ from those around the time of suicidal and self-harming thoughts and behaviours. This makes it challenging to accurately determine the temporal directionality and the strength of this relationship, as well as making it difficult to advance knowledge regarding the psychological mechanisms driving these relationships. As such, it is important to gain new insights using intensive longitudinal designs with short follow up periods and novel innovative approaches such as daily diary and experience

sampling methodologies. This direction of research is likely to be particularly informative given the dynamic and fluctuating nature of sleep parameters and self-harm risk over time (Bryan & Rudd, 2016). Further, investigations of this nature will determine whether symptoms of sleep disturbance aid the process of identifying which young people are at imminent risk of harming themselves.

Fourth, research in adolescents to date has exclusively measured sleep using subjective (mainly questionnaire) measures. This is not surprising given the predominance of large school-based samples in this literature and that subjectively experienced sleep problems provide valuable information that has potential clinical relevance. That being said, research in a high-risk sample of young adults (with a history of suicidal ideation and attempts) has recently demonstrated the value of including objective measures of sleep in advancing understanding of suicide and self-harm risk. Future research should determine whether these findings replicate in an adolescent population.

Finally, the majority of studies included within this review were conducted in the US and Korea, with individual studies being conducted in other countries internationally. Given that sociocultural factors have been shown to influence sleep, it is not possible to apply these findings worldwide. For example, in Asian cultures, bedtimes are usually later, and sleep time shorter, than Northern American and European cultures. Further, school start times in America are significantly earlier than across the United Kingdom. It is possible that the relationship between sleep problems, suicide, and self-harm may be more pronounced in some cultures than others. More geographically widespread research would allow for cross-cultural comparisons and for the collection of data that has the potential to inform international policy (e.g., regarding delaying school start times). For example despite

90% of adolescents living in lower and middle-income countries, and over 75% of deaths by suicide taking place in that part of the world (WHO, 2014), there is a dearth of research examining the link between sleep disturbance, suicide, and self-harm in low and middle income countries

3.5.2. Strengths and limitations of the current review

The major strengths of this review are that a comprehensive literature search was conducted in line with PRISMA guidelines, reliability checks were implemented, and all research critically evaluated against methodological criteria. This provides an overview of the quality of the evidence. Further, by focusing on adolescent samples in particular, we have been able to obtain a more nuanced understanding of the evidence relating to the link between sleep, suicide, and self-harm in young people aged 10 to 19. In considering the strengths and limitations of the evidence we have, most importantly, been able to develop a research agenda tailored to progressing our understanding of this association in adolescents. However, the findings should be considered in light of the inclusion criteria. For example, only peer reviewed articles written in the English language were considered. Although there are advantages of this approach it is possible that this creates a bias towards studies that report positive findings.

3.5.3. Conclusions

Preventing suicide and self-harm in young people is of critical importance. This is the first review to systematically evaluate and critically appraise research evidence investigating the role of poor sleep in self-harming and suicidal thoughts and behaviours in adolescents. Notwithstanding methodological limitations, the available evidence base suggests that the experience of sleep disturbance during

adolescence is linked to an increased risk of suicide and self-harm. Whilst it is unlikely that symptoms of sleep disturbance (or any single risk factor) will predict suicide and self-harm risk in isolation, the evidence presented in this review suggests that experiencing sleep disturbance may increase the likelihood that an adolescent will think about or engage in self-harming and suicidal thoughts and/or behaviours. As such, poor sleep should be considered alongside - and in relation to - a range of other theoretically relevant variables. Substantial heterogeneity has hampered consolidation of evidence within this field and, as a result, there is still significant progress to be made in terms of understanding this relationship. Future research should focus on determining which sleep parameters, and indeed sleep disorders, are associated with risk of suicide and self-harm, and aim to establish which interrelating psychological processes drive this relationship. This research has the potential to facilitate the identification of young people at risk of suicide and self-harm, and contribute to prevention and intervention efforts that support vulnerable young people within school, community, and clinical settings.

3.6. Research agenda

1. Employ prospective, longitudinal, and experience sampling research designs. This will allow researchers to determine if poor sleep is a risk factor for suicidal and self-harm thoughts and behaviour, in the short term and within daily life, and will increase the ecological validity of results.

2. Conduct investigations, which combine subjective and objective sleep assessments to examine a wide range of sleep and circadian parameters within each investigation. This will advance understanding regarding which

specific sleep-related constructs are important in pathways to self-harming and suicidal thoughts and behaviour.

3. Establish if symptoms of poor sleep distinguish between those who think about suicide/self-harm and those who engage in self-harm or attempt suicide.

4. Determine if sleep profiles distinguish between young people who have engaged in self-harm (with and without suicidal intent) one occasion vs. multiple times.

5. Assess sleep-related constructs as well as suicide and self-harm related outcomes using standardised measures that have been shown to be reliable and valid within adolescent samples. This will allow for comparison between studies.

6. Evaluate novel candidate mechanisms linking sleep, its effects, and sleep disorders to suicidal and self-harming thoughts and behaviours in adolescents based on theoretically derived hypotheses from prominent models of suicide and self-harm.

7. Employ mixed-methods research designs, which include collecting qualitative reflections from young people on the nature of the relationship between sleep, suicide, and self-harm.

8. In order to inform political and clinical decision-making, and allow for cross-cultural comparisons, more internationally diverse research is necessary. In particular, there is a need to examine the link between sleep problems, suicide, and self-harm in low and middle-income countries.

Chapter 4: Do symptoms of sleep disturbance predict future self-harm thoughts and behaviour in young people? A six-month prospective investigation

4.1. Chapter Overview

Converging evidence identifies sleep disturbance as a risk factor for suicidal thoughts, suicide attempts, non-suicidal self-injury and self-harm in young people. Despite the multidimensional nature of adolescent sleep health, most research has focused on a narrow range of sleep parameters. The main objective of this study was to conduct a detailed assessment of the relationship between sleep disturbance and subsequent self-harm thoughts and behaviours. High school students (n=1045) completed an anonymous self-report survey at baseline and 573 were followed up six months later. The questionnaire included questions on self-harm thoughts, self-harm behaviours, depressive symptomology and assessed a range of sleep parameters. Young people who reported elevated insomnia symptoms were significantly more likely to think about harming themselves in the six-month period that followed. Adolescents who were experiencing symptoms of insomnia and/or poor sleep quality were at significantly increased risk of engaging in subsequent self-harm behaviours. Findings demonstrate that distinct sleep problems are not uniformly associated with risk of self-harm thoughts and behaviours. Insights provided by the current investigation have implications for future research, theoretical conceptualisations of self-harm, and the development of empirically-driven approaches to self-harm risk assessment and prevention during adolescence.

4.2. Introduction

In Chapter 3, the current research literature examining the relationship between symptoms of adolescent sleep disturbance, suicide and self-harm was discussed extensively. The investigations summarised in the systematic review suggest that young people who report poorer sleep may be at increased risk of experiencing suicidal thoughts, suicide attempts, non-suicidal self-injury and self-harm (irrespective of suicidal intent). These relationships were demonstrated in young people recruited from both clinical and community settings. Whilst this research has provided valuable insights into the association between sleep problems and suicide/self-harm risk, Chapter 3 highlighted several methodological challenges that currently limit the generalisability of these findings. First, there is a predominance of cross-sectional research designs. Second, the majority of investigations have not taken the complexity of adolescent sleep disturbance into account and have focused on a narrow range of sleep related constructs. Third, non-standardised measures of sleep and self-harm (thoughts and behaviours) have been frequently utilised.

The majority of work within this field of research has been cross-sectional in nature and has assessed sleep disturbance and suicide/self-harm related constructs using disjointed assessments periods (i.e. sleep in the past month vs. lifetime self-harm behaviour). This makes it difficult to generate evidence-based inferences regarding the directionality of this relationship. As a result, it is not yet clear whether symptoms of sleep disturbance represent a correlate of, or a risk factor for, suicide and self-harm in young people. Chapter 3 demonstrates that longitudinal evidence is limited within this field of research and that further prospective studies are required

to determine whether sleep problems are associated with an increased risk of future self-harm thoughts and acts.

Of the fifty-six investigations included within the systematic review, fewer than 10% (n=5) were prospective in design. The results of these longitudinal studies suggest that trouble sleeping and daytime sleepiness predicted subsequent suicidal ideation (Liu et al., 2018; Wong & Brower, 2012). However, experiencing nightmares and being overtired did not (Wong & Brower, 2012). Trouble initiating or maintaining sleep predicted both suicidal thoughts and suicide attempts (Strandheim et al., 2014; Wong & Brower, 2012). Another investigation noted that, in girls only, poor sleep was associated with non-suicidal self-injury in the following year (Lundh et al., 2013), whilst further research demonstrated that trouble sleeping was associated with self-harm (irrespective of suicidal intent) (Wong et al., 2011). Whilst these investigations do represent a positive step towards better understanding the potential role of sleep as a modifiable risk factor for suicide and self-harm, they have been narrow in terms of their assessment of sleep related constructs. For example, the majority of research has examined the role of insomnia and nightmares, and few expand their focus to include additional sleep parameters (i.e., sleep onset latency, sleep efficiency). As such, it is not clear which specific aspects of sleep disturbance are important, and if some sleep related-constructs are associated with greater risk of subsequent suicide attempts, or acts of self-harm, than others. Consequently, there is a need for prospective research, which takes the multidimensionality and complexity of adolescent sleep health into consideration.

It is important to note at this stage that only one prospective investigation has implemented the broader operationalisation and assessment of self-harm behaviours (irrespective of motivation). This is not surprising given that most research examining

this relationship has been conducted in countries outside the European Union (who distinguish between suicidal behaviour and non-suicidal self-injury). Further, no research has explored the relationship between symptoms of sleep disturbance and adolescents' thoughts of self-harm (irrespective of motivations). This is problematic as many more young people will think about self-harm than will go on to intentionally harm themselves. Investigations of this nature are critical in understanding the onset and persistence of self-harm in young people, as thoughts are a proximal predictor to behaviour. Identifying modifiable predictors of self-harm, that trigger the start of this trajectory in young people, will be helpful in developing effective self-harm and suicide prevention strategies. Further, given the distress associated with experiencing these thoughts, they deserve research attention in their own right (Jones & Joiner, 2019). As a broader conceptualisation of self-harm is in line with national clinical guidelines in the UK (NICE, 2004; 2011), comprehensive assessment of the relationship between sleep disturbance and this operationalisation of self-harm is necessary if we are to meaningfully inform policy and practice at a national level.

Another challenge limiting the validity and generalisability of prospective research within the field is the frequent implementation of brief and non-specific assessment of sleep and self-harm. In order to obtain a more precise and fine-grained understanding of this relationship, research should employ specific, standardised and validated measures throughout. This is particularly important where the measurement of clinically significant symptoms of sleep disorders are concerned. For example, to date, prospective research has relied on single item assessments of insomnia. This is problematic as a diagnosis of insomnia relies on the endorsement of impaired daytime functioning (APA, 2013), which single item

measures do not take into consideration. As such, it has not yet been possible to obtain an accurate representation of the relationship between insomnia and subsequent self-harm thoughts and behaviours in young people.

To date, Hysing and colleagues (2015) have conducted the most comprehensive investigation of the relationship between sleep problems and self-harm (with and without suicidal intent) during adolescence. This cross-sectional research demonstrated that a wide range of sleep disturbances (short sleep duration, taking longer to fall asleep, waking up during the night, sleeping longer at the weekend and greater sleep efficiency) were associated with an increased risk of reporting lifetime self-harm when adjusting for perfectionism and symptoms of depression and ADHD. This was also the case for young people reporting clinically salient symptoms of insomnia. A significant dose-response relationship between sleep problems and the frequency of lifetime self-harm was revealed, whereby sleep disturbance was more common amongst young people who reported a history of self-harm repetition, relative to those describing a single episode of self-harm. Whilst this investigation benefited from the assessment of multiple sleep parameters, used a definition of insomnia based on published quantitative criteria, and adhered to a standardised definition and measurement of self-harm (employed internationally in the CASE study), it is not yet clear whether these findings apply to the prediction of future self-harm. This information is important if researchers are to establish whether sleep disturbance is a risk factor for the onset and repetition of intentional self-injury or self-poisoning (irrespective of motivation or intent).

4.2.1 The current study

The present study was designed to address each of the aforementioned limitations in order to extend existing literature within this research field. For the first time, we aimed to conduct a detailed assessment of the relationship between sleep disturbance and subsequent self-harm thoughts and behaviours using a prospective research design. More specifically, the aims of the current study were to:

1. Establish the prevalence of sleep problems, self-harm thoughts, and self-harm behaviours in Scottish adolescents.

2. Examine whether symptoms of adolescent sleep disturbance predict future self-harm thoughts and acts over a six-month period.

3. Determine if sleep parameters predict the subsequent onset and repetition of self-harm behaviours in young people.

4. Establish whether symptoms of sleep disturbance distinguish between adolescents who prospectively report first time vs. repeat episodes of self-harm.

We generated four hypotheses. First, based on the results of existing prospective investigations, it was predicted that adolescents experiencing symptoms of sleep disturbance would be at greater risk of experiencing self-harm thoughts during the six-month follow up period. Second, it was expected that adolescents reporting poor sleep would be more likely to engage in future acts of self-harm. Third, it was expected that young people in both self-harm groups (first-time and repeat), would report elevated sleep problems relative to those who have no history of harming themselves. Fourth, it was predicted that adolescents reporting repetition of self-harm would demonstrate poorer sleep than those who

report engaging in self-harm for the first time (since baseline). Given that this study

is the first to implement such a detailed assessment of individual sleep parameters

within the context of a prospective research design, this study is largely exploratory

in nature. As a result, predictions have been made regarding the overall

relationships between sleep disturbance and self-harm risk in young people, but we

have not developed hypotheses regarding specific sleep parameters due to a lack

of available evidence on which to base these expectations.

4.3. Methods

4.3.1. Participants

At baseline (T1), we recruited 1045 adolescents (52.8% female) from 25

mainstream schools across Scotland. We recruited 28% of the target schools to this

study. This is consistent with previous research investigating self-harm in

adolescents (Hawton et al., 2002; O'Connor et al., 2009). Ages ranged from 15-17

years (M=15.35, SD=0.68). In terms of ethnicity, 97.2% of the sample was White.

This is consistent with the 2011 Scottish Census. There was representation from

urban (n=16) and rural (n=5) locations. The average percentage of pupils eligible for

free meals in 2014 was 18.8%. This is widely used as a proxy for socioeconomic

status. The schools participating in the present study had a range of 5.8% to 29.4%

(M=17.8%, SD=8.12) of pupils that were eligible for free meals. This range was

narrower than that of Scotland as a whole (Range: 1.44-69.23%, M=15.6%,

SD=9.56).

Of the initial sample, 54.8% (n=573) completed measures at both time points

and all analyses were constrained to this subsample. Reasons for non-participation

at 6-month follow up (T2) included absence due to sickness or holidays, engagement

in alternative activities, and truancy (n=305). Further, one school withdrew their participation between T1 and T2 (n=167). Using t-tests and chi-squared tests, it was determined that those who completed the measures at 6-month follow up were similar to those who did not, in terms of gender and all symptoms of sleep disturbance (p>0.05). However, adolescents who did not complete measures at T2 reported greater depressive symptoms at T1 (t (1045) =3.70, $p < .001$, Cohen's d =.02) and were more likely to have a history of engaging in self-harm behaviour (X^2 (1) = 5.65, $p = .018$, Phi = .02. However, these differences were small in magnitude.

4.3.2. Measures

An overview of the constructs assessed within this chapter and the measures implemented to examine them is presented in Table 4.1. All measures were completed at both time points.

Demographic factors. Information on age, gender and ethnicity was collected in order to characterise the study sample.

Insomnia symptoms. The Sleep Condition Indicator (SCI: Espie et al., 2014) is a clinical screening tool that can be used to assess insomnia symptoms against DSM-V diagnostic criteria for Insomnia Disorder. The measure comprises nine items, which assess concerns about initiating/maintaining sleep, early morning awakening, subjective sleep quality, impact on daily functioning (al within the past month), as well as duration and frequency of the sleep problem. Items are measured on a 5-point scale (0-4), with higher scores reflecting better sleep. Total SCI scores are calculated as a sum of all item responses (possible range: 0-36). Scores of ≤ 16 are indicative of possible Insomnia Disorder. The SCI demonstrated robust internal consistency in the current sample (α=0.83). Further, the measure has shown

convergent validity with the Pittsburgh Sleep Quality Index and Insomnia Severity Index as well as predictive validity in relation to Insomnia Disorder diagnosed by expert clinical interview (Espie et al., 2014). The SCI has recently been demonstrated to have sound psychometric properties in a large sample (n=200,000) of adolescents and young adults (Espie et al., 2017). Whilst a clinical cut-off is available for this measure, individuals' total scores also provide a dimensional view of their experience of insomnia symptoms (i.e., where they fall on a continuum of symptom severity). In this investigation, participant's SCI scores were included as a continuous predictor variable.

Nightmares. The Disturbing Dreams and Nightmare Severity Index (DDNSI, Krakow, 2002) was employed to assess clinically salient difficulties with nightmares. The scale assesses the number of nights that nightmares are experienced, the total number of nightmares experienced, the number of awakenings due to nightmares (0=never/rarely, 4=always), the severity of the nightmare problem and also the intensity of the nightmares themselves. Severity and intensity are measured on a Likert-type scale ranging from no problem/not intense at all (0) to very severe problem/extremely severe intensity (6). The time period covered by the measure is determined by how often participants experience disturbing dreams and nightmares (i.e., never/weekly/monthly/yearly). Total scores range from 0-37, with higher scores representing a greater difficulty with nightmares. This measure has previously been employed in a clinical sample (n=50) of young people aged 12-17 (Kaplan et al., 2014), has been applied frequently within the field of suicide research (McCall et al, 2013; Nadorff et al, 2014; Nadorff et al, 2013), and also demonstrated good internal consistency within the current sample (α=0.86). Whilst a clinical cut-off is available

for this measure, participant's DDNSI scores were included as a continuous predictor variable in this investigation.

Sleep continuity, duration and timing. The Munich Chronotype Questionnaire (Roenneberg, 2003) was used to assess self-reported sleep-wake behaviour. The measure gathers information regarding individuals' sleep-wake habits on school days and free days (i.e. weekends). This has the advantage that researchers have the opportunity to collect accurate data on adolescent's *actual* sleep timing on scheduled days and on days where social constraints are removed. More specifically, the MCTQ asks separately for workdays and work-free days; at what time people go to bed and are ready to sleep, how long it takes them to fall asleep, at what time they wake up and get up, and if they use an alarm clock. The following sleep variables were calculated from this data: sleep onset latency on school nights, total sleep time on school nights, sleep efficiency on school nights, chronotype and social jetlag. Further information regarding the computation of these variables is presented in Table 4.1.

Subjective sleep quality. Subjective sleep quality was assessed using question five from the Sleep Condition Indicator (SCI: Espie et al., 2014). Participants were asked to rate their sleep quality on a typical night during the past month on a 5-point Likert scale (0-4) ranging from "very good" to "very poor". This single item measure was included to reduce participant burden and to avoid the inclusion of questions similar to other measures employed in the study. For example, employing the Pittsburgh Sleep Quality Index (Buysse, 1989) would require participants to answer further questions about difficulties initiating sleep etc. Young people scoring ≤ 2 on this item were classified as experiencing poor quality sleep. This threshold was determined by the SCI scoring guidelines.

Depressive symptomology. The 7-item depression subscale of the Hospital Anxiety and Depression Scale (HADS: Zigmond & Snaith, 1983) is a valid and reliable measure of depressive symptomology, which is frequently used in community settings (O'Connor et al., 2012; Nielsen, Sayal & Townsend, 2018, White, Leach, Sims, Atkinson, & Cottrell, 1999). Participants are asked to indicate the extent to which they have experienced depressive symptoms in the past week on a Likert scale ranging from 0-3, and total scores are calculated by taking a sum of all responses. This measure has been validated for use in adolescent samples and internal consistency was shown to be good in the present sample (α=0.86). Research has demonstrated that both sleep problems and self-harm are linked to depression. As a result, the HADS was included in the current study so that severity of depression could be adjusted for within our statistical analyses.

Thoughts of self-harm. History of self-harm thoughts was assessed using a single item, "Have you ever thought about taking an overdose or trying to harm yourself but not actually done so?" Participants were asked to provide a binary response (yes/no). This measure has been used to assess self-harm thoughts in a range of school-based surveys across Europe (Hawton, Rodham & Evans, 2006; Madge et al., 2008; O'Connor et al., 2009). At the second time point, participants were asked to consider if they had thought about trying to harm themselves since completing the previous survey but not actually done so. As such, we were able to determine whether respondents had thought about self-harm, for the first time ever, during the follow up period.

Self-harm behaviour. Acts of self-harm were assessed using one question taken from the Child and Adolescent Self-harm in Europe (CASE: Hawton et al., 2006) survey. Adolescents were initially asked if they had ever deliberately taken an

overdose (e.g., of pills or other medication) or tried to harm themselves in some other way (e.g., cutting themselves). Those who reported having engaged in self-harm were asked to think about their last act of self-harm and to describe in their own words (in as much detail as they felt comfortable with) how they had harmed themselves on that occasion. We asked young people to provide a description of their most recent experience of self-harm so that we were able to determine whether they met the CASE definition of self-harm: "an act with a non-fatal outcome in which an individual deliberately did one or more of the following: initiated behaviour (e.g., self-cutting, jumping from a height), which they intended to cause self-harm; ingested a substance in excess of the prescribed or generally recognised therapeutic dose; ingested a recreational or illicit drug that was an act the person regarded as self-harm; ingested a non-ingestible substance or object" (Hawton et al., 2006, p. 28). Finally, in line with the original CASE study, young people were asked to indicate if their most recent episode of self-harm was explained by any of the following motives: "I wanted to show how desperate I was feeling", "I wanted to die", "I wanted to punish myself", "I wanted to frighten someone", "I wanted to get my own back on someone", "I wanted to get relief form a terrible state of mind", "I wanted to find out if someone really loved me" and 'I wanted to get some attention'.

Participants were asked about their history of self-harm at baseline (T1). During the follow up (T2) assessment (six months later) they were asked if they had engaged in self-harm since participating in the first survey. As a result, we were able to establish if adolescents had intentionally harmed themselves during the follow up period, and whether they had engaged in first time or repeat self-harm during this time. We chose to implement questions from the CASE study in assessing self-harm as they offered a number of advantages. These items are standardised, can be

understood by adolescents, and have been employed in school-based studies internationally (Hawton et al, 2006; Madge et al., 2008; O'Connor et al., 2014). Importantly, robust and transparent criteria are provided for classifying acts of self-harm and the questions provide the opportunity to obtain other important information regarding the characteristics of a young person's self-harm (e.g., frequency of the acts and the motivations associated with them).

A six-month follow up period was chosen in line with other prospective investigations which have aimed to examine the short term prediction of self-harm during adolescence (e.g., Glazebrook, Townsend, & Sayal, 2015; O'Connor et al., 2009; Rasmussen et al., 2016; O'Connor et al., 2017). This follow up period was deemed appropriate for three reasons. First, previous research in Scotland has demonstrated that a "significant minority" of young people would engage in self-harm during a six-month prospective period (O'Connor et al., 2009). Second, repetition of self-harm often occurs in the months following the first episode (Arensman et al., 2016). Therefore, this follow-up period will likely capture incidences of repeat harm in those who report a recent history of self-harm at baseline. Third, a six-month follow up period was considered most feasible within the context of demanding school timetables.

Table 4. 1. Overview of sleep variables examined within this chapter

Variable	Measure used	Additional information
Insomnia	Sleep Condition Indicator (Espie et al., 2014)	Range: 0-36 Scores of ≤ 16 are indicative of probable insomnia disorder
Nightmares	Disturbing Dreams and Nightmares Severity Index (Krakow et al., 2002)	Range: 0-37 Scores of ≥ 10 are indicative of clinically salient nightmares.
School Night Sleep Onset Latency	Munich Chronotype Questionnaire (Roenneberg, 2003)	Time from intention to sleep, to sleep onset in minutes (e.g., 15 minutes).
School Night Total Sleep Time	Munich Chronotype Questionnaire (Roenneberg, 2003)	Number of hours and minutes spent asleep during the night (e.g., 7:30). Computation: subtracting sleep onset from wake up time.
School Night Sleep Efficiency	Munich Chronotype Questionnaire (Roenneberg, 2003)	The percentage of time in bed that is spent asleep (e.g., 82%). Computation: (total sleep time/ time spent in bed) x 100.
Subjective Sleep Quality	Question 5 from the Sleep Condition Indicator.	Appraisals of sleep quality rated on a five point Likert Scale from 0 – 4 (Very Poor – Very Good).

Chronotype	Munich Chronotype Questionnaire (Roenneberg, 2003)	Preference of timing of sleep-wake defined as the midpoint between sleep onset and offset on free days (adjusted for individual sleep need) e.g., 4.30
		Computation: Mid-sleep on free days – (total sleep time on free days – average weekly total sleep time)/2
Social Jet Lag	Munich Chronotype Questionnaire (Roenneberg, 2003)	Misalignment between internal biological time and external social time
		Computation: mid-sleep on a free day – mid sleep on a school day

4.3.3 Procedure

Ethical approval was obtained from the University Ethics Committee (UEC16/47) and the investigation adhered to the Ethical Guidelines published by both the British Psychological Society and the British Educational Research Association's Ethical Guidelines. Once permission had been received from local education authorities, school gatekeepers and parents/guardians, young people were invited to participate in the study. All participants provided informed consent and pupils were aware of their right to anonymously withdraw participation at any time during the investigation.

Respondents completed an anonymous self-report survey at two time points, six months apart. The research team ensured that data collection did not take place in the lead up to, or during, exam periods. This decision was taken given that exam stress has been shown to compromise sleep quality (Ahrberg, Dresler, Niedermaier,

Steiger, & Genzel, 2012) and is associated with self-harm in young people (Rodway et al., 2016). Surveys were completed within a school setting (i.e., within classrooms and assembly halls) and the author of the current thesis was present during each research visit to ensure that the research protocol was adhered to. In order to reinforce the private and confidential nature of the survey, young people answered questions under exam conditions (i.e. independently and in silence), the order of questions was counterbalanced, and participants sealed their completed questionnaires in an envelope before being returned to the researcher. Respondents generated a six digit unique reference code by completing a series of questions that required alphanumeric responses at both time points. This allowed the research team to match response at follow up, whilst maintaining the anonymity of the pupils that were participating. All young people were debriefed and provided with an information sheet that contained contact details for a range of local physical and mental health support services.

4.3.4. Data analytic strategy

IBM SPSS Statistics 25 for Windows (IBM Corp, Armonk, NY, USA) was used to conduct all statistical analyses. Inspection of histograms revealed skewness across most independent variables. Accordingly, medians and interquartile ranges were calculated. Eight univariate logistic regressions were conducted to examine the relationships between each sleep variable and subsequent self-harm thoughts. These analyses were followed by multivariate logistic regressions that adjusted for the following covariates: gender, depressive symptomology and, history of self-harm thoughts. Eight univariate logistic regression analyses were performed to examine the associations between each sleep variable and prospective self-harm behaviour.

As with all analyses pertaining to self-harm thoughts, these analyses were followed by multivariate logistic regressions, which adjusted for the following covariates: gender, depressive symptomology, and history of self-harm behaviours.

Given that self-harm engagement groups (self-harm thoughts vs. no self-harm thoughts and self-harm behaviours vs. no self-harm behaviour) were unequal and that assumption of homogeneity of variance was violated (for sleep onset latency, total sleep duration, sleep efficiency, social jet lag, nightmares and depression) bootstrapping was applied in all logistic regression analyses. Bootstrapping is a non-parametric re-sampling technique in which repeated samples are taken from the original dataset to estimate the sampling distribution of a statistic. In this study, analyses were based on 5000 sample bootstrap replications. Multicollinearity checks were conducted on all predictor variables included within the regression analyses. Correlations between variables were less than .6, variation inflation factors (VIF) were below 5, and tolerance statistics were above .2. As such all values were within the acceptable levels, indicating that multicollinearity was not an issue within the regression model (Field, 2018).

In order to address the third and fourth aims of the current investigation, multinomial logistic regression models were utilised to determine whether sleep parameters (that emerged as significant within the initial analyses) distinguished between adolescents within different self-harm subgroups. When determining whether sleep parameters predicted first time and/or repeat self-harm, the reference group was young people with no history of self-harm. Alternatively, when establishing if symptoms of sleep disturbance distinguish between adolescents reporting first time vs. repeat self-harm (during the prospective follow up period), the reference group was adolescents who reported harming themselves for the first time.

Given that gender, severity of depressive symptoms, and history of self-harm have been shown to be robust predictors of self-harm, these were included as covariates within these analyses. The power calculation which was based on the main multivariable logistic regression analyses, suggested that a minimum sample of 988 was required to detect a small effect size (OR = 1.30; (based effects reported in Hysing et al. (2014)) given α = 0.05 and power = 0.95. To control for the number of comparisons we employed Holm's sequential Bonferroni correction method throughout.

Whilst data were collected from individual pupils who were nested within their respective schools, it was determined that multilevel modelling analysis would not yield different results from non-multilevel techniques. This decision was supported by the fact that participants' school did not significantly predict self-harm and that intra-class correlation coefficients suggested that there was no relationship between observations within schools).

4.4. Results

4.4.1. Preliminary results

Of the young people who took part at baseline, 28.5% (n=298) endorsed having ever thought about harming themselves. Within this subgroup, 37.6% (n=112) had thought about engaging in self-harm but never acted on these thoughts, whilst 62.4 % (n=186) reported that these thoughts had progressed to actions. Of the adolescents who completed the survey at both time points, 16.2% (n=92) had thought about self-harm during the six-month follow up period. Exactly 50% (n=46) of these adolescents had acted on these thoughts. Descriptive statistics are presented separately for adolescents who reported having experienced self-harm thoughts

between Time 1 and Time 2 vs. adolescents who had not thought about harming themselves during the six-month follow up period (Table 4.2).

Table 4. 2. Demographic, sleep related and psychological variables in adolescents stratified by prospective self-harm thoughts group (no self-harm thoughts between T1 and T2 vs. self-harm thoughts between T1 and T2).

	No self-harm thoughts	Self-harm thoughts
	(n=481, 83.8%)	(n=92, 16.2%)
Demographic variables		
Age, Mdn (IQR)	15.28 (1.00)	15.25 (1.00)
Gender		
Girls, % (n)	50.1 (241)	71.7 (66)
Boys, % (n)	49.9 (240)	29.30 (26)
Sleep variables		
School night sleep onset latency, Mdn (IQR)	20.00 (17.00)	23.00 (30:00)
School night sleep duration, Mdn (IQR)	7.30 1.65)	7.00 (1.85)
School night sleep efficiency, Mdn (IQR)	86.90 (11.95)	79.93 (19.44)
Chronotype, Mdn (IQR)	5.26 (1.62)	5.45 (1.99)
Social Jetlag, Mdn (IQR)	2.26 (1.43)	2.60 (1.39)
SCI Score, Mdn (IQR)	29.00 (8.25)	22.00(13.00)
DDNSI Score, Mdn (IQR)	1.12 (7.25)	6.50 (12.92)
Poor sleep quality, % (n)	39.6 (191)	60.9 (56)
Psychological variables		
Depression, Mdn (IQR)	3.00 (4.00)	4.00 (5.00)

Mdn. Median

Of the young people who took part at baseline, 17.8% (n=186) endorsed having ever engaged in self-harm. The majority (80.8%) of this subsample reported having harmed themselves on more than one occasion, whilst 19.2% described a single episode of self-harm. Most young people (83.5%) reporting a history of self-harm had engaged in these acts within the past year, with the recency of the behaviour ranging from the morning of the day of data collection, to three years prior to baseline survey completion. Participants reported that between 1 and 7 motives

drove their decision to engage in self-harm (M=1.8, SD= 0.99). The most common reason young people described for harming themselves was to get relief from a terrible state of mind (46.5%), followed by wanting to die (34.6%) and wanting to punish oneself (29.6%). Of the adolescents who completed self-harm measures at both time points, 8.1% (n=46) reported having engaged in self-harm during the six-month follow up period. The majority (67.3%) of these young people described repetition of self-harm since T1, whilst the remaining 32.7% endorsed having engaged in self-harm for the first time between baseline and follow up.

In terms of sleep disturbance, 11.9% of the sample reached the threshold for probable Insomnia Disorder at baseline, with 83.8% reporting difficulties initiating sleep, 46.8% endorsed trouble maintaining sleep, and 46.3% demonstrated issues with early morning awakening. Further 19.8% reported experiencing clinically salient nightmares. Almost a quarter of respondents (23.5%) noted taking longer than 30 minutes to fall asleep on school nights, whilst almost three quarters (73%) reported obtaining less than eight hours sleep (i.e. the minimum amount of recommended sleep for adolescents). Approximately half of the adolescents participating in the study described poor sleep efficiency (48.8%) and/or poor subjective sleep quality (45.7%). Descriptive statistics are presented separately for young people who engaged in self-harm between Time 1 and Time 2 and adolescents who did not (Table 4.3).

Table 4. 3. Demographic, sleep related and psychological variables in adolescents stratified by prospective self-harm group (no self-harm behaviour between T1 and T2 vs. self-harm behaviour between T1 and T2).

	No self-harm (n=527, 91.9%)	Self-harm (n=46, 8.1%)
Demographic variables		
Age, Mdn (IQR)	15.00 (1)	15.00 (1)
Gender		
Girls, % (n)	271 (48.3)	8 (17.4)
Boys, % (n)	253 (51.7)	38 (82.6)
Sleep variables		
School night sleep onset latency, Mdn (IQR)	20.00 (17.00)	30.00 (26.25)
School night sleep duration, Mdn (IQR)	7.30 (1.65)	6.30 (1.96)
School night sleep efficiency, Mdn (IQR)	86.6 (12.31)	77.9 (17.63)
Chronotype, Mdn (IQR)	5:26 (1.59)	5.45 (1.97)
Social Jetlag, Mdn (IQR)	2.20 (1.43)	2.56 (1.25)
SCI Score, Mdn (IQR)	29.00 (8.00)	19.50 (10.00)
DDNSI Score, Mdn (IQR)	1.12 (7.00)	10.25 (14.32)
Poor sleep quality, % (n)	26.1 (12)	73.9 (34)
Psychological variables		
Depression, Mdn (IQR)	3.00 (4.00)	4.00 (5.00)

Mdn. Median

4.4.2. Do symptoms of sleep disturbance predict subsequent self-harm thoughts?

The results from the series of binary logistic analyses examining the relationship between symptoms of sleep disturbance and future self-harm thoughts are presented in Table 4.4. The unadjusted analyses demonstrated that all sleep variables were associated with significantly increased odds of thinking about self-harm behaviour T1 and T2. This was also the case when gender was included as a covariate.

Adjusting for symptoms of depression reduced the strength of the association between most sleep variables and self-harm. However, all remained significant with

the exception of social jetlag. Controlling for depressive symptoms slightly attenuated the associations between acts of self-harm and most symptoms of sleep disturbance. Greater reductions in odds ratios, for sleep duration, chronotype, and poor sleep quality resulted when controlling for depression. However, these significant relationships persisted. The results demonstrated that with each one hour reduction in sleep duration, young people were 43% more likely to report subsequent thoughts self-harm. Further, with each out delay in chronotype (i.e., greater eveningness), adolescents were 33% more likely to have thought about harming themselves between baseline and follow up. Finally, young people who perceived their sleep to be of poor quality were almost two times more likely to report thinking about self-harm than those who reported good quality sleep.

Controlling for previous self-harm thoughts was responsible for the greatest attenuation in the strength of the relationships between sleep variables and subsequent thoughts of self-harm. When accounting for gender, depression and an adolescent's history of self-harm thoughts (and applying Holm's sequential Bonferroni correction), only sleep duration (OR=.727, 95% CI .601-.879), insomnia symptoms (OR=.901, 95% CI: .858, .947), clinically salient nightmares (OR: 1.06, 95% CI: 1.02-1.08) and poor sleep quality (OR = 1.67, 1.02, 2.73) were found to predict prospective self-harm thoughts. With each one-hour decrease in sleep duration, young people were 37% more likely to have thought about self-harm. Each one unit decrease on the SCI (i.e., indicating increased insomnia symptomology) and one unit increase on the DDNSI (i.e., indicating more frequent, severe and intense nightmares) was associated with an 8% and 5% increase in risk of experiencing subsequent self-harm thoughts respectively. Further, young people reporting poor sleep quality were 67% more likely to report having thought about self-harm between

baseline, and T2. Finally, when all significant sleep-related constructs are entered into the analysis, only elevated insomnia symptoms and a history of self-harm thoughts emerged as independent predictors of subsequent self-harm thoughts.

Table 4. 4. Univariate and multivariate logistic regression predicting self-harm thoughts between baseline (T1) and follow up (T2)

	Unadjusted analyses [c]		Fully adjusted analyses [d]	
	OR	95% CI	OR	95% CI
School night sleep onset latency (school)[b]	**1.02**	1.01,1.03	1.00	.99,1.02
School night total sleep time (school)[a]	**.649**	.544,.774	**.727**	.601,.879
School night sleep efficiency (school)[a]	**.971**	.955,.987	.984	.967,1.00
Chronotype	**1.40**	1.18,1.68	**1.26**	1.04,1.52
Social jet lag	**1.28**	1.06,1.54	1.19	.980,1.45
Insomnia symptoms (SCI)[a]	**.894**	.866,.922	**.924***	.892,.957
Nightmares (DDNSI)[b]	**1.10**	1.07,1.13	**1.05***	1.02,1.09
Poor subjective sleep quality	**2.37**	1.50,3.74	**1.67***	1.02,2.73

Notes.   Statistically significant associations are highlighted in bold.

*associations survived Holm's sequential Bonferonni correction within adjusted analyses

[a] Higher values indicate better sleep/less sleep disturbance, [b] Lower values indicate poorer sleep/greater sleep disturbance

[c] Analyses with covariates excluded, [d] Adjusted for gender, depressive symptoms, history of self-harm thoughts.

4.4.3. Do symptoms of sleep disturbance predict future acts of self-harm?

The results from the series of binary logistic analyses examining the relationship between symptoms of sleep disturbance and subsequent self-harm are presented in Table 4.5. The unadjusted analyses demonstrated that all sleep variables, apart from social jetlag, were associated with significantly increased odds of engaging in self-harm behaviour T1 and T2. This was also the case when gender was included as a covariate.

Adjusting for symptoms of depression reduced the strength of the association between most sleep variables and self-harm. However, all remained significant with the exception of chronotype. Controlling for depressive symptoms slightly attenuated the associations between acts of self-harm and most symptoms of sleep disturbance. Greater reductions in odds ratios, for sleep duration and poor sleep quality resulted when controlling for depression. However, these significant relationships persisted. The results demonstrated that with each hour reduction in sleep duration, young people were 65% more likely to report subsequent self-harm. Further, young people who perceived their sleep to be of poor quality were over three times more likely to report self-harm than those who reported good quality sleep.

Controlling for previous self-harm behaviour was responsible for the greatest attenuation in the strength of the relationships between sleep variables and subsequent self-harm. When accounting for gender, depression and adolescent's self-harm history (and applying Holm's sequential Bonferroni correction), only

insomnia symptoms (OR=.901, 95% CI: .858, .947) and poor sleep quality (OR = 2.30, 1.50, 6.70) were found to be independent predictors of self-harm risk. With each one-unit decrease in the SCI (i.e. indicating increased insomnia symptomology), adolescents were 10% more likely to harm themselves during the follow up period. Therefore, within the fully adjusted analysis, young people reporting elevated symptoms of insomnia and/or sleep quality were at increased risk of future self-harm.

Table 4. 5. Univariate and multivariate logistic regression predicting self-harm behaviours between baseline (T1) and follow up (T2)

	Unadjusted analyses [d]		Fully adjusted analyses [e]	
	OR	95% CI	OR	95% CI
School night sleep onset latency (school)[b]	**1.02**	1.01,1.04	1.01	.993,1.02
School night total sleep time (school)[a]	**.576**	.458,.724	.731	.566,.943
School night sleep efficiency (school)[a]	**.962**	.943,.981	.980	.957,1.00
Chronotype [b]	**1.34**	1.07,1.68	1.12	.853,1.46
Social jet lag [b]	1.21	.943,1.53	1.06	.802,1.41
Insomnia symptoms (SCI)[c]	**.872**	.837,.908	**.901***	.862,.950
Nightmares (DDNSI) [b]	**1.11**	1.07,1.15	**1.05**	1.01,1.09
Poor subjective sleep quality [b]	**4.24**	2.14,8.38	**3.17***	1.50,6.70

Notes.   Statistically significant associations are highlighted in bold.

*associations survived Holm's sequential Bonferonni correction within adjusted analyses

[a] Higher values indicate better sleep/less sleep disturbance, [b] Higher values indicate poorer sleep/ greater sleep disturbance, [c] Lower values indicate poorer sleep/greater sleep disturbance, [d] Analyses with covariates excluded, [e] Adjusted for gender, depressive symptoms, history of self-harm thoughts

4.4.4. Do sleep parameters predict the subsequent onset and repetition of self-harm?

Multinomial logistic regression tests were applied to address the third aim of the study. Results are presented in Table 4.6. Descriptive statistics demonstrated that the severity of insomnia symptoms were greatest in young people who reported repetition of self-harm, followed by those who engaged in self-harm for the first time during follow up, and then controls reporting the lowest symptom severity. Median scores were 29.00 (8.00), 21.50 (8.25) and 18.50 (12.00) respectively. The results of the multinomial logistic regression demonstrated that both self-harm groups (first time and repeat) differed significantly from young people reporting no history of self-harm behaviour in terms of insomnia symptoms. That is to say, young people who scored lower on the SCI were at increased risk of engaging in first time (OR=.936, 95% CI: .818, .946), or repeat (OR=.858, 95% CI: .818, 909) self-harm. With each one-unit decrease on the Sleep Condition Indicator adolescents were 7% more likely to report harming themselves for the first time, and 16% more likely to endorse repetition of self-harm.

Examination of the frequency of poor sleep quality demonstrated that adolescents within the repeat self-harm subgroup reported the greatest prevalence of clinically salient poor-quality sleep (74.2%), followed by the first-time self-harm subgroup (73.3%) and adolescents with no history of self-harm (23.6%). In line with findings pertaining to insomnia symptoms, the results of the multinomial logistic regression analyses highlighted that subjective perceptions of poor sleep quality differentiated between adolescents in both self-harm groups and adolescents with no history of self-harm. More specifically, adolescents reporting this symptom of sleep disturbance were over four times more likely to report first time (OR=4.40, 95% CI,

1.35, 14.33) and over three times more likely to report repeat self-harm (OR=3.55, 1.50,8.40).

4.4.5. Do symptoms of sleep disturbance distinguish between adolescents who report first time vs. repeat episodes of self-harm prospectively over a six-month period?

Multinomial logisitc regression tests were applied to address the final aim of the study. Results demonstrated that first time and repeat self-harm subgroups did not differ significantly in terms of symptoms of insomnia (p=.562) or with regards to the prevalence of adolescents perceiving their sleep to be of poor quality (p=.771). Results are presented in Table 4.5.

Table 4. 6. Univariate and multivariate multinomial logistic regression predicting self-harm status (no self-harm vs. first time self-harm vs. repeat self-harm) between baseline (T1) and follow up (T2)

		No self-harm vs. First time self-harm (T1-T2)		No self-harm vs. Repeat self-harm (T1-T2)		First time self-harm vs. Repeat self-harm (T1-T2)	
		OR	95% CI	OR	95% CI	OR	95% CI
Insomnia symptoms (SCI)	Unadjusted [a, c]	**.901**	.845,.961	**.860**	.819,.903	.952	.880,1.03
Insomnia symptoms (SCI)	Adjusted [a, d]	**.936***	.818,.946	**.858***	.818,.909	.975	.894,1.06
Poor subjective sleep quality	Unadjusted [b, c]	**4.31**	1.36,13.69	**4.52**	1.98,10.30	1.24	.296,5.17
Poor subjective sleep quality	Adjusted [b,d]	**4.40***	1.35,8.40	**3.55***	1.35,14.33	1.04	0.19,3.38

Notes.   Statistically significant associations are highlighted in bold.

*associations survived Holm's sequential Bonferonni correction within adjusted analyses

[a] Higher values on SCI indicate better sleep/lower severity of insomnia symptoms [b] Higher values on subjective sleep quality indicate worse sleep/poorer sleep quality. [c] Analyses with covariates excluded, [d] Adjusted for gender, depressive symptoms, history of self-harm thoughts

4.5. Discussion

The current study is the first to conduct a detailed assessment of the relationship between symptoms of sleep disturbance and self-harm (with and without suicidal intent), within the context of a prospective research design. The aims of the current study were fourfold. First, we sought to establish the prevalence of sleep problems, self-harm thoughts, and self-harm behaviours in Scottish adolescents. Second, we set out to examine whether several symptoms of adolescent sleep disturbance predicted any future acts of self-harm. Third, we sought to obtain a more fine-grained understanding of this relationship, by determining whether sleep parameters would predict the onset and repetition of self-harm in young people. Fourth, we wished to establish whether symptoms of sleep disturbance would distinguish between adolescents who engaged in self-harm for the first time between baseline and follow up, relative to those who reported repetition of self-harm.

4.5.1. Sleep problems and self-harm in adolescents in Scotland

As well as advancing knowledge regarding the relationship between sleep disturbance and future self-harm thoughts and behaviours in adolescents, the current study provides novel insights into the scale of these public health issues amongst adolescents in Scotland. Research conducted within a UK context is necessary in order to inform decision-making (in terms of policy and practice) at a national level.

4.5.1.1. Sleep disturbance

Published research investigating adolescent sleep health in Scotland, and across the UK more broadly, is lacking. Most work to date has focused on North America, Australia or East Asia (e.g., Gradisar et al., 2011; Jiang et al., 2015; Paksarian, Rudolph, He, & Merikangas, 2015; Short et al., 2013a; Zhang et al., 2017). Given the consequences of poor sleep in terms of health and wellbeing, there is a clear need for evidence specific to Scotland. Overall, the proportion of adolescents fulfilling criteria for clinical indicators of sleep disturbances was high. This is in line with similar investigations which have been conducted in the US (National Sleep Foundation, 2006), Australia (Short et al., 2013a) and Norway (Hysing et al., 2013). Most young people reported that on average they do not obtain the minimum recommended sleep duration for adolescents aged 14-17 years old on school nights. Further, both insomnia symptoms (11.9%) and clinically salient nightmares (19.5%) were common within this sample, which is in line with previous explorations of adolescent sleep (Hysing et al., 2013, Arora et al., 2014). Overall, our findings are in line with international data (Gradisar et al., 2011), and suggest that adolescent sleep disturbances represent a public health issue for adolescents that warrant further attention in Scotland.

4.5.1.2. Self-harm thoughts and behaviours

Within the current investigation, almost one third (28.5%) of young people reported having thought about harming themselves at some point in their lifetime. This is similar to prevalence rates reported from a large-scale European survey of young people aged 15-16-year-old (n=45,806) (30.8%, Kokkevi et al., 2012). Approximately 16% of young people indicated that they had thought about harming

themselves during the six-month follow up period. This is in line with the 12-month prevalence rate of self-harm thoughts reported by O'Connor et al. (2009) in their Scottish school-based investigation.

Our findings demonstrate that almost 18% of young people reported a lifetime history of self-harm behaviour. These findings are in line with earlier investigations conducted elsewhere in Europe (Geulayov et al., 2018; Madge et al., 2008; Mars et al., 2014), but are higher than prevalence rates that have been reported from previous work conducted in Scotland (13.8%, O'Connor et al., 2009; 12.6%, Quigley et al., 2017). Each of these investigations assessed history of self-harm with the same single item measure (taken from the CASE survey) and as a result, heterogeneity in measurement will not account for the variation in prevalence rates. As such, it is possible that differences could be due to diversity in sampling strategies. Whilst all three investigations recruited adolescents from high schools in Scotland, there are inconsistencies in the age ranges within the samples and the areas (local education authorities) from which young people were enlisted. Within the current investigation efforts were made to obtain an accurate and updated picture of the scale of this public health problem

Data for the current study was collected almost eight years after that of O'Connor et al. (2009), and almost three years after that of Quigley et al. (2017). As such, it should also be considered that there has in fact been an increase in the number of young people engaging in self-harm over time in Scotland. A similar pattern has been witnessed elsewhere in the UK (McManus et al., 2019). Whilst the mechanisms underlying differences in prevalence rates remains uncertain, it is clear that self-harm thoughts and behaviours in Scotland represents significant concerns. This is reinforced by our finding that eight per cent of adolescents reported engaging

in self-harm during the six-month follow up period, a third of whom did so for the first time. Further, over two thirds of adolescents reporting prospective self-harm endorsed having done so on more than one occasion. This is in line with previous research, which highlights that the repetition of self-harm is common (Madge et al., 2008, O'Connor et al, 2009). This is concerning as young people who engage in repeat self-harm are more likely to attempt suicide in the future (Mars et al., 2019).

4.5.2. Sleep disturbance and subsequent self-harm thoughts and behaviours behaviour during adolescence

The current investigation extends the existing literature by examining a wide range of sleep variables in relation to future self-harmful thoughts and acts of self-harm during adolescence. Results demonstrated that several sleep parameters were associated with an increased likelihood of thinking about self-harm or engaging in self-harm behaviour between Time 1 and Time 2. More specifically, taking longer to fall asleep, shorter sleep duration, poorer sleep efficiency, experience of nightmares, insomnia symptoms and poor sleep quality all predicted future thoughts and acts of self-harm within a short-term follow up period. These relationships persisted when controlling for depressive symptomology. Whilst adjusting for depression had a minimal impact on the strength of the relationship between most sleep variables and self-harm, greater reductions were apparent when considering the influence of sleep duration and sleep quality on subsequent risk of self-harm behaviour, and sleep duration, chronotype and sleep quality of risk of future self-harm thoughts. This provides preliminary evidence to suggest that the role of pre-existing depression within this relationship may not be uniform and could vary as a function of the sleep parameter being assessed. As highlighted in the previous chapter, the limited body of existing prospective research has investigated a narrow range of sleep variables

and inconsistent patterns of results have emerged as to whether the link between sleep and subsequent self-harm is independent of depression (Liu et al., 2019; Lundh et al., 2013; Strandheim et al., 2014; Wong et al., 2011; Wong & Brower, 2012). The current study has the advantage of employing validated measures of sleep, self-harm, and depression, and as a result builds on the findings of previous research in the area.

One particularly noteworthy finding, which emerged from the current study is that the relationships between several sleep variables and subsequent self-harm thoughts or behaviours were no longer significant when accounting for adolescents' reports of prior self-harm. Previous self-harm predicts future behaviour (Hawton et al., 2012; Mars et al., 2019) and, within the current study, young people with a history of harming themselves were over 17 times more likely to report subsequent acts than those who had never engaged in self-harm. When adjusting for previous self-harm thoughts, only elevated insomnia symptoms independently predicted that a young person would think about self-harm during the follow up period. When controlling for previous self-harm behaviours, only insomnia symptoms and perceptions of poor sleep quality significantly predicted subsequent acts of self-harm.

Previous prospective investigations examining the relationship between insomnia symptoms and subsequent suicidal thoughts have reported mixed findings. Whist Wong and Brower (2011) noted that young people endorsing insomnia symptoms at baseline were more likely to experience suicidal thoughts during the following year, other studies have reported contradictory findings (Liu et al., 2018; Strandheim et al., 2014). These findings may differ as a result of employing different operationalisations and measures of insomnia symptoms. The current study

advances our understanding of the relationship between insomnia and self-harm thoughts by using a valid and reliable measure of this sleep problem, which was developed according to the most up to date diagnostic criteria (Espie et al., 2014). Further, our research focused on self-harm thoughts more broadly whilst previous investigations have focused on self-harmful thoughts that are specifically associated with suicidal intent. This difference in conceptualisation may account for inconsistencies between our findings and those of previous studies.

The significant link between symptoms of sleep disturbance and self-harm behaviour is in line with previous research examining self-harm irrespective of motivation (Wong et al., 2011), non-suicidal self-injury (Lundh et al., 2013) and suicide attempts (Wong et al., 2012). However, in examining multiple symptoms of sleep disturbance, the current investigation provides a more fine-grained understanding by demonstrating that not all aspects of sleep independently predict future self-harm when previous thoughts and behaviour is accounted for. This finding highlights the importance of accounting for young people's history of self-harm and demonstrates the ways in which prospective research can further our understanding of the complex nature of these relationships.

Whilst Hysing et al. (2015) demonstrated consistent relationships across a wide range of sleep problems, the authors focused on lifetime history of self-harm, rather than predicting future behaviours. Given that similar measures were employed across both studies, our findings provide preliminary evidence to suggest that some symptoms of sleep disturbance may be predictors of subsequent intentional self-harm, whilst others may represent correlates. These results have implications for future research by highlighting the value of assessing multiple aspects of sleep and

demonstrating the importance of taking previous self-harm thoughts and behaviours into account.

Within the current investigation, young people experiencing insomnia symptoms at baseline were more likely to report having thought about harming themselves during the follow up period, whilst both insomnia symptoms and sleep quality were shown to be independent predictors of future self-harm during adolescence. These findings support our hypotheses. To date, no research has examined the link between sleep problems and self-harm thoughts, and only one previous study has investigated the role of insomnia in relation to prospective self-harm. Wong and colleagues (2011) demonstrated that insomnia symptoms at age 12-14 (defined as "trouble sleeping") increased the likelihood that a young person would report having harmed themselves by age 15-17. These findings persisted when controlling for prior acts of self-harm and depressive symptoms at baseline. Whilst the work of Wong et al. (2011) provided valuable insights into the relationship between insomnia symptoms and future self-harm, the researchers relied on single item measures of insomnia, depressive symptoms and self-harm. The current study demonstrates that these findings replicate when measures that are more stringent are employed. Hysing et al., (2015) were the first to demonstrate that insomnia (as operationalised by DSM-V diagnostic criteria) was associated with an increased likelihood of reporting lifetime self-harm. The results of the current study demonstrate that these findings extend to predict future acts of self-harm and that the relationship persists when accounting for a history of self-injurious behaviour.

It is noteworthy that some of the validated quantitative symptoms of sleep disturbance, which characterise insomnia (i.e. longer sleep latency, short sleep duration, and poor sleep efficiency), do not predict future self-harm thoughts or acts

when accounting for history of self-harm phenomena. It is possible that other aspects of insomnia drive the relationship between young people's score on the condition indicator and self-harm risk. For example, one cross-sectional investigation in a sample of undergraduate students demonstrated that the duration of insomnia symptoms was significantly associated with suicide risk independent of current symptoms when controlling for anxiety symptoms, depressive symptoms, and posttraumatic symptoms (Nadorff, Nazem, & Fiske, 2013). As such, it may be that insomnia symptom duration accounts for this relationship during adolescence.

Furthermore, previous prospective investigations (Liu et al., 2018; Lundh et al., 2013; Strandheim et al., 2014; Wong et al., 2011; Wong & Brower, 2012) have relied on single item measures of insomnia and as a result, this is the first study to employ a validated measure of insomnia, which assesses all aspects of the DSM-V criteria. The SCI includes four items, which tap into the qualitative aspects of insomnia (Espie et al., 2014). These assess an individual's satisfaction with the quality of their sleep, as well as the daytime consequences of poor sleep (i.e. effects on mood, energy or relationships and, effects on concentration, productivity or ability to stay awake). As such, it is possible that the daytime impairment associated with poor sleep, or the confluence of nocturnal and daytime insomnia symptoms, increases the likelihood that a young person will think about or engage in self-harm. Future research should set out to obtain a more nuanced understanding of this complex relationship, in order to determine which aspects of insomnia best predict self-harm risk in adolescents.

As well as insomnia symptoms, sleep quality independently predicted future risk of self-harm in adolescents. Young people who perceived their sleep to be of poor quality were over three times more likely to have harmed themselves during the

six-month prospective period. The current study extends the existing literature as despite sleep quality being a core dimension of adolescent sleep health, no previous research has investigated sleep quality in relation to self-harm (irrespective of underlying motivation). Findings from cross-sectional research examining the association between sleep quality and non-suicidal self-injury have so far been inconsistent, such that it is not clear whether this relationship is explained by depressive symptoms or not (Bandel & Brausch, 2020; Liu et al., 2017).

One challenge facing the field of sleep research is that despite being widely used by researchers and clinicians, the construct of sleep quality is complex and poorly defined (Buysse et al., 1989; Harvey, Stinson, Whitaker, Moskovitz, & Virk, 2008). This is reflected in heterogeneity of measurement, with some investigations assessing sleep quality using validated measurements, which incorporate a wide range of more objective sleep disturbances (Bandel & Brausch, 2020), whilst others employ single item measures of sleep quality which assess individuals own perceptions of their sleep quality more broadly (Liu et al., 2017). Whilst the general consensus is that the construct of sleep quality refers to an individual's overall subjective appraisal of whether the quality of their sleep is good or poor, it remains unclear what drives these perceptions, or what constitutes subjectively good quality sleep.

Research applying qualitative techniques suggests that adults use multiple criteria to determine their sleep quality (Harvey et al., 2008), and that factors affecting this appraisal can occur during the night, as well as upon wakening, and throughout the day (Harvey et al., 2008; Ramlee, Sanborn, & Tang, 2017). Future research should aim to determine whether the findings also apply to adolescent populations, or whether there are nuances in the factors contributing to subjective

perceptions of sleep quality within this unique developmental period. Investigations of this nature would have implications for theory, measurement and intervention within the field of sleep research and sleep medicine.

4.5.3. Sleep disturbance in relation to the onset and repetition of self-harm

The current investigation aimed to extend the literature by providing a more nuanced understanding of the relationship between symptoms of sleep disturbance and future self-harm. We established that greater insomnia symptoms and subjective sleep quality were independently associated with self-harm across a short-term follow up period. As highlighted in Chapter 1, both the onset and repetition of self-harm is common during adolescence. Consequently, there is a need to establish whether these specific sleep problems predict both first time and repeat self-harm during this developmental period. The current study yielded preliminary evidence in support of our second hypotheses by demonstrating that, within multivariate analyses, insomnia symptoms and poor sleep quality were predictive of both the onset and repetition of self-harm behaviours within this sample of Scottish adolescents. Given that this is the first study to examine sleep problems within this context, future replication is necessary.

To provide a more refined understanding of the relationship between sleep and self-harm during adolescence, it is important to determine whether there are differences in the sleep disturbance profiles of individuals who have engaged in self-harm once, compared with multiple times. Previous research comparing these subgroups is sparse, with only one investigation exploring this with an adolescent population (Hysing et al, 2015). The authors noted that the prevalence of insomnia was greater amongst adolescents who reported having ever harmed themselves two

times or more (48%), relative to those who had engaged in self-harm in one occasion (37%).

We were interested in establishing whether these findings replicated to prospective self-harm and hypothesised that young people reporting multiple acts of self-harm would report poorer sleep at baseline than those who had engaged in self-harm behaviour for the first time. Findings did not support this prediction, as there were no significant differences between these subgroups in terms of insomnia symptoms and perceptions of sleep quality. This was particularly surprising with regards to insomnia symptoms, as when investigating the prevalence of insomnia disorder within these self-harm subgroups, differences were greater (41.9% vs. 26.7%) than those reported in the investigation conducted by Hysing and colleagues. However, it is important to highlight at this stage that a relatively small number of participants engaged in self-harm between time-points. Future research should aim to replicate this investigation using a larger sample in order to determine whether there are in fact no differences between subgroups, or whether there was insufficient power within the current investigation to detect these effects (i.e., our power analysis highlighted that 998 participants were required to detect small effects, and 573 young people completed measures at both time points). Previous cross-sectional research in adults with a history of suicide attempts demonstrated that nightmare frequency, but not nightmare chronicity or distress, differentiated between adults who had attempted suicide once, and those who had attempted to take their own lives on multiple occasions (Speed, Drapeau, & Nadorff, 2018). It would be of interest to investigate these characteristics of distinct sleep problems (i.e. frequency, duration and severity) to determine if they distinguish between adolescents belonging to

different self-harm subgroups. Information pertaining to these characteristics was not collected within the context of the current investigation.

4.5.4 Strengths and Limitations

The current study has two main strengths. First, the prospective design of the current investigation provides novel insights into the role of insomnia symptoms and sleep quality as potential risk factors for future thoughts and acts of self-harm. By collecting longitudinal data, we have been able to take a positive step beyond examining sleep disturbance as a correlate of these thoughts and behaviours, which is valuable in understanding the role of sleep problems in the pathways to the onset and repetition of self-harm. Only one previous investigation (Hysing et al., 2015) has investigated sleep in relation to the repetition of self-harm in young people, and it relied on retrospective self-report of participant's lifetime history of self-harm behaviour. Prospective studies are likely to provide more robust and reliable information concerning the repetition of self-harm thoughts and behaviour (Hawton et al, 2012). In order to advance knowledge regarding the prediction of self-harm, future research should implement novel and innovative approaches, such as daily-diary or experience sampling methodologies, to provide valuable information regarding the temporal dynamics of this relationship.

Second, standardised and validated measures were used throughout the current investigation (with the exception of sleep quality, which was assessed using a single item measure taken from a multi-item measures of insomnia). This was the first study examining the relationship between self-harm and sleep disturbance, which applied all of the most up to data criteria in the assessment of insomnia symptoms and captured the multidimensional nature of this sleep disorder. Further,

in measuring adolescents' history of self-harm, we employed the CASE definition and survey questions. These items have been employed in school-based studies internationally. Classifying adolescents' descriptions as self-harm according to transparent criteria adds methodological rigour to the current investigation and encourages consistency and comparability across studies.

Despite these strengths, findings should be interpreted within the context of the following three limitations. First, and most notably, attrition was high between waves of data collection and one school withdrew their participation entirely (n=167). The follow up response rate of the current investigation was 54.8%, which is lower than that of another longitudinal study of self-harm in Scotland (69.8%; O'Connor et al., 2009). As such, it is possible that this attrition bias may have influenced our results in terms of prevalence estimates and associations. That being said, adolescents who took part in the second wave of data collection had broadly similar profiles across the majority of variables compared with those who did not.

However, those lost to attrition were more likely to report a history of self-harm at baseline. This has been reported in previous research (Mars et al., 2016) and is not surprising given that young people who engage in self-harm are more likely to be absent or truant from school (Epstein et al., 2019). Therefore, we were less likely to capture these individuals at follow up, or they may have been absent at baseline and therefore excluded from the current study. As our study is likely to have underestimated the number of participants that engaged in repeat self-harm, our findings should be interpreted with caution. Were we able to include the entire sample, it is possible that we would have had a greater proportion of participants reporting prospective self-harm. Another consequence of attrition at follow up was less statistical power to detect effects. Whilst the investigation was adequately

powered (n=1045) to detect effects of a small magnitude at baseline, the resulting sample size at follow up was only sufficient to identify medium effect sizes. This is important as effects of even a small magnitude can be clinically relevant. Future research should aim to determine whether our findings replicate in a larger sample of adolescents

Second, the results of the current study were based solely on self-report data and required adolescents to accurately (and honestly) report their experiences of sleep, self-harm and symptoms of depression. Data of this nature can be limited by recall and response biases. However, whilst it is important to consider the limitations of this method of data collection, self-report measures are particularly valuable when investigating topics of a sensitive and private nature (i.e., self-harm). Further, recall biases may be somewhat offset by the short nature of the follow up period. This is possible as self-harm acts that are more recent have been shown to be more accurately reported over time (Mars et al., 2016). Further, we took steps to increase the likelihood that participants would feel comfortable providing honest answers to questions of a sensitive nature. We highlighted and reinforced the confidentiality and anonymity of their data, made it clear that we were an independent research team, and confirmed that no individuals outside the research team would have access to participants' individual responses.

Third, whilst our investigation comprised a detailed assessment of sleep parameters in relation to self-harm, our assessment of adolescent sleep was not exhaustive. We collected data on sleep continuity, duration and timing using the Munich Chronotype Questionnaire (MCTQ). This measure was chosen as it enquires about actual sleep and wake times and considers weekday-weekend differences in sleep timing. However, the MCTQ does not assess wakefulness during the night.

This omission means that calculations for total sleep duration and sleep efficiency may be overestimates, and that the relationship between these sleep variables and prospective self-harm may be an underestimation of the true effect. Future investigations should incorporate a measure of wakefulness after sleep onset (WASO). Despite these limitations, we believe that the current investigation makes a novel contribution to the field of self-harm research and that our findings may have implications for future research and clinical practice.

4.4.5. Implications

Given that the onset and repetition of self-harm typically occurs during adolescence, there is a need to identify which young people are most vulnerable to thinking about and engaging in these behaviours. The findings presented within this chapter reinforce the results of previous research by highlighting that young people who experience symptoms of sleep disturbance are more likely to think about and engage in self-harm. The current project encourages progress in the field by providing a more nuanced understanding of this relationship. It does so by demonstrating that not all sleep-related constructs are useful in the prediction of future self-harm risk when important covariates are accounted for. The fact that distinct sleep problems were not uniformly associated with risk demonstrates the value of moving beyond the examination of generalised sleep disturbance and suggests that researchers should continue to incorporate the assessment of multiple dimensions of adolescent sleep when investigating the prediction of self-harm thoughts and behaviour. Within the current investigation, it was demonstrated that adolescents who reported poor quality sleep were at increased risk of engaging in self-harm behaviour. It is therefore surprising that perceptions of poor quality sleep

did not independently predict subsequent self-harm thoughts. The finding that relationships varied according to different symptoms of sleep disturbance has implications for theoretical conceptualisations of the psychological pathways linking sleep disturbance to self-harm thought and behaviour.

Clinically, our findings suggest that risk assessments and treatment plans should focus on more specific sleep problems and highlight that insomnia symptoms and perceptions of poor sleep quality could be potentially useful indicators in the identification and support of young people at risk of engaging in self-harm. Further, incorporating these sleep related constructs into programmes based in schools and the community may be beneficial. Within our multivariate analyses, history of self-harm, insomnia symptoms and poor sleep quality were independently associated with future acts of self-harm. This finding is noteworthy as sleep disturbance is modifiable, whilst a history of engaging in self-harm is not open to change. Recent findings suggest that cognitive-behavioural techniques are associated with improvements in sleep, anxiety and depression during adolescence (Blake et al., 2017). Future research should seek to determine whether the treatment of these insomnia symptoms and overall poor sleep quality might improve resilience against the onset and repetition of self-harm thoughts and behaviours during adolescence.

Whilst our findings extend the existing literature, several key empirical questions remain. The next chapter details further exploration of the data collected within the school-based investigation presented within the current chapter. Further analysis of the dataset was conducted in order to obtain a more nuanced understanding of the relationship between symptoms of sleep disturbance, self-harm risk, and the psychological mechanisms accounting for this link.

4.6. Key points from Chapter 4:

1. The existing body of research evidence examining sleep and self-harm during adolescence suggests that young people who report sleep may be at increased risk of self-harm thoughts and behaviours. However, an overreliance of cross-sectional research designs, narrow focus in terms of sleep-related constructs, and frequent use of non-standardised measures limits the validity and utility of current findings.

2. The study presented within this chapter was designed to address these methodological challenges and extend previous research by conducting the first detailed assessment of the relationship between sleep disturbance and subsequent self-harm thoughts and behaviours using a prospective research design.

3. Both sleep problems and self-harm (thoughts and behaviours) represent public health concerns for adolescents in Scotland. A range of sleep variables was associated with future self-harm thoughts and acts. Only symptoms of insomnia significantly predicted future thoughts of self-harm, whilst insomnia symptoms and perceptions of poor sleep quality emerged as independent predictors of subsequent self-harm behaviour when accounting for young people's self-harm history. These sleep problems were associated with both the onset and repetition of self-harm during adolescence, but did not distinguish between adolescents reporting self-harm for the first time and those who had harmed themselves on multiple occasions.

4.7. Next steps

1. Whilst the investigation presented in Chapter 4 provided a more nuanced understanding of the complex relationships between sleep and self-harm, it is not yet clear why this relationship exists. Chapter 5 will test predictions derived from the Integrated Motivational-Volitional Model of Suicidal Behaviour, to advance knowledge regarding the psychological processes driving the link between symptoms of sleep disturbance and self-harm.

2. The findings presented in this chapter suggest that insomnia symptoms are associated with self-harm thoughts and behaviours. Poor sleep quality also predicted self-harm over a short-term prospective period. However, both sleep disturbances and self-harm are dynamic, and can fluctuate over time. Despite this, no studies to date have accounted for the varying nature of these phenomena (within daily life) and investigated whether symptoms of sleep disturbance predict self-harm thoughts and behaviours the next day. Chapter 6 presents the first daily-diary investigation of this relationship in order advance this field of research.

Chapter 5: Why are sleep problems associated with self-harm risk during adolescence? Investigating the role of defeat and entrapment

5.1. Chapter Overview

The findings presented in the previous chapter demonstrated that insomnia symptoms were associated with increased risk of self-harm thoughts in young people. However, the psychological processes driving these associations are not yet known. The current investigation aimed to examine the factor structure of the Entrapment Scale in young people, in order to guide further analyses. In addition, this research aimed to test predictions - informed by the Integrated Motivational-Volitional (IMV) Model of Suicidal Behaviour - concerning the role of feelings of defeat and entrapment within the sleep-suicide relationship. The work presented in the current chapter is based on further analyses of data collected during the school-based investigation described in Chapter 4, with the addition of measures of defeat and entrapment. The results of the confirmatory factor analysis support a two-factor structure of the Entrapment Scale, suggesting that entrapment is best conceptualised as bidimensional in adolescents (i.e., internal and external entrapment). Perceptions of defeat, internal entrapment and external entrapment were elevated in young people who reported clinically salient insomnia, relative to those who did not. Insomnia and subsequent self-harm thoughts were linked via perceptions of defeat and internal entrapment (when adjusting for depression and history of self-harm thoughts). Taken together, our findings offer novel insights regarding the relationship between sleep disturbances and self-harm thoughts while reinforcing the importance of feeling defeated and perceiving thoughts and feelings

to be inescapable as potentially transdiagnostic psychological constructs within pathways to self-harm. Implications for research, theory and clinical practice are discussed.

5.2. Introduction

In order to determine whether sleep disturbances represent a modifiable risk factor for the onset and persistence of self-harm (with and without suicidal intent), prospective evidence is required. The study described in Chapter 4 was the first investigation to examine the relationship between a wide range of sleep-related constructs and subsequent self-harm thoughts and behaviours using a short-term prospective research design. The results of this work highlighted that young people who reported elevated symptoms of insomnia were more likely to have experienced subsequent self-harm thoughts. Further, young people reporting symptoms of insomnia and/or perceived their sleep to be of poor quality were at increased risk for the onset and repetition of self-harm during the six-month follow up period. Finally, the investigation presented in Chapter 4 provides preliminary evidence to suggest that these symptoms of sleep disturbance did not distinguish between adolescents who report engaging in self-harm on one occasion compared with multiple times during the follow up period. Whilst these findings do extend current understanding regarding the relationship between sleep disturbance and self-harm risk, the mechanisms underlying this link remain unclear.

5.2.1. The role of psychological factors in the relationship between sleep disturbance and self-harm during adolescence

Both cross-sectional (Hysing et al., 2015) and prospective (Wong et al., 2011) research has demonstrated that young people experiencing symptoms of sleep disturbance are more likely to think about and engage in self-harm. However, it is not yet known *how* or *why* sleep problems confer increased risk for the development and maintenance of these thoughts and behaviours. Within the field of suicide and self-harm research, moving beyond main effects models to more complex theoretically informed conceptualisations of risk (involving mediators and moderators) has been highlighted as a priority for future investigations (Glenn et al., 2018; Kleiman & Anestis, 2015; O'Connor, 2011). This knowledge is key if we are to better understand this relationship and develop tailored interventions that have the potential to effectively reduce and prevent self-harm in young people who experience symptoms of sleep disturbance.

Several reviews of the literature have suggested that psychological factors may mediate the relationship between sleep disturbance and self-harm/suicide risk (Littlewood et al., 2017; McCall & Black, 2013; Russell et al., 2019; Winsper & Tang, 2014; Woznica, Carney, Kuo, & Moss, 2015). This is justified given the central role of psychological factors in the onset and repetition of self-harming and suicidal thoughts and behaviours (Holmes et al., 2018; Joiner, 2005; Nock & O'Connor, 2014; O'Connor & Kirtley, 2018; Owen et al., 2018). Furthermore, various psychological models have contributed to significant advances in our understanding of the complexity of these phenomena (Barzilay & Apter, 2014; O'Connor et al., 2016; O'Connor & Portzky, 2018).

Within ideation-to-action models (those that aim to conceptualise the transition from self-harm thoughts to acts of self-harm), thinking about suicide or self-harm (i.e., the intention to harm oneself) is a proximal predictor of behavioural enactment (O'Connor, 2011; O'Connor & Kirtley, 2018). As such, an important first step in understanding why sleep problems are associated with increased risk of self-harm and suicide is to investigate the psychological factors linking poor sleep and self-harming/suicidal thoughts. Whilst research has begun to uncover the psychological processes and mechanisms through which symptoms of sleep disturbance may confer increased risk of suicidal ideation in adults (Littlewood et al, 2016), investigations of this nature in adolescents are in their infancy. On commencement of this thesis, no published investigations had examined the pathways or mechanisms underlying this relationship within the adolescent population. Since then, one study assessing the interrelationships between sleep problems (specifically insomnia and nightmares), intermediate psychological processes, and suicidal thoughts has been published in young people (Zullo et al., 2018). The results of this study provide preliminary evidence to suggest that psychological factors (at least partially) explain the association between sleep problems and suicidal thoughts in young people.

Zullo et al. (2017) examined the relationship between sleep disturbance and suicide risk through the lens of the Interpersonal-Psychological Theory of Suicide (Joiner, 2007; Van Orden, 2010). The authors highlighted that in a clinical sample of young people, insomnia symptoms were indirectly related to an increased likelihood of having thought about suicide and/or developed a suicide plan in the past 24 hours (via feelings of depression and perceived burdensomeness). That is to say that, symptoms of insomnia are associated with depressive symptoms as well as the

perception of being a burden or a liability to others. In turn, these feelings are linked

to elevated suicide risk. The results of this investigation advance our understanding

of the psychological mechanisms linking insomnia and suicide risk in young people

and demonstrate that psychological models of suicide provide useful frameworks for

investigating mediators of this relationship. However, it is important to bear in mind

that, although this study provides valuable insights, it focusses exclusively on

thoughts that are specifically motivated by suicidal intent, and no research has

employed a broader operationalisation of self-harm. As a result, it is not yet clear

whether these findings will extend to self-harm thoughts irrespective of motivation.

As this is the preferred operationalisation of self-harm in Europe, it is important to

establish if whether this pattern of results replicate so that it can be determined

whether these pathways are relevant to future policy and practice at a national level.

All investigations that have examined the interrelationships between sleep

disturbances, psychological factors, and suicidal thoughts have applied cross-

sectional research designs. Future research should seek to determine which

psychological processes drive the link between symptoms of sleep disturbance and

subsequent risk of self-harm thoughts (with and without suicidal intent) and should

be conducted through the lens of psychological theory. The Integrated Motivational-

Volitional Model of Suicidal Behaviour (IMV) (O'Connor, 2011; O'Connor & Kirtley,

2018) is advantageous in this context as it provides the most detailed account of

empirically supported pathways and processes involved in the development of self-

harm thoughts and behaviours. In doing so, the model highlights candidate

mediators that may underpin the relationship between sleep and self-harm thoughts

in young people. As a result, investigations conducted from the perspective of the

IMV could advance understanding regarding the psychological pathways that drive this relationship.

5.2.2. The IMV: A theoretical framework for examining the psychological pathways linking sleep disturbance and self-harm thoughts

The IMV is a tripartite framework previously described in detail in Chapter 1 (subsection 1.9). At its core, the IMV hypothesises that perceptions of defeat and entrapment are key drivers of the intention to self-harm. More specifically, the model hypothesises that when an individual perceives themselves to be trapped by internal and/or external factors in their life, they develop self-harm thoughts. This intention emerges as engaging in self-harmful behaviours is seen as the salient solution to escaping their life thoughts, feelings and/or life circumstances. These feelings of entrapment are triggered by perceptions of defeat/humiliation, which are often associated with a range of background and triggering factors, including stress. There is a substantial body of evidence supporting the hypothesised role of defeat and entrapment as part of the psychological pathways that give rise to self-harm (Rasmussen et al., 2010; O'Connor, 2003; Littlewood et al., 2016a; Littlewood et al., 2016b). However, defeat and entrapment have not yet been examined during adolescence.

Sleep problems are not included within the IMV model. However, findings from adults (Littlewood et al., 2016b) support the existence of a pathway from sleep disturbance to suicidality, via defeat and entrapment (the central components of the IMV's motivational phase). Specifically, preliminary evidence supports the hypothesis that experience nightmares act as background vulnerability factors (within the pre-motivational phase of the IMV), and these sleep disturbances are associated with increased perceptions of defeat and entrapment, which in turn are associated with

elevated suicide risk. It remains to be seen whether this hypothesised multi-step

pathway applies to the development of future thoughts of self-harm (with and without

suicidal intent) and to other types of sleep disturbance (i.e., insomnia) within an

adolescent population (Figure 5.1).
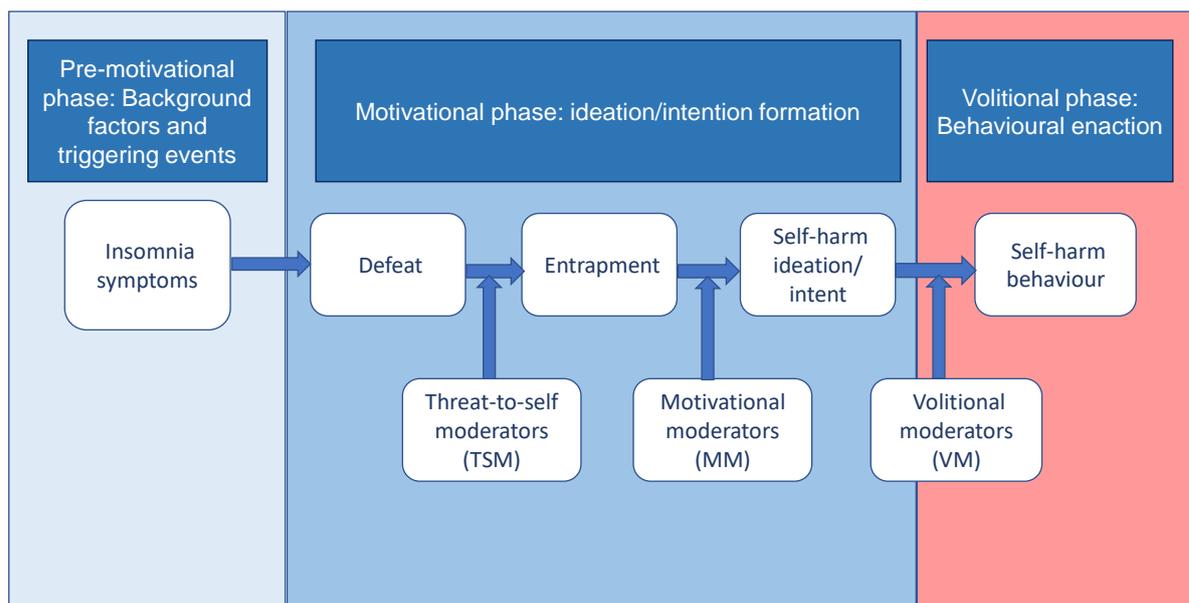
Figure 5. 1. A modified visual representation of the Integrated Motivation-Volitional Model of Suicidal Behaviour (highlighting the hypothesised position of sleep disturbance) (IMV; O'Connor, 2011; O'Connor & Kirtley, 2018)

5.2.3. The need to understand the relationship between defeat, entrapment and self-harm during adolescence

Whilst evidence consistently supports the assertion that feeling trapped is a

key driver of self-harm risk (O'Connor & Portzky, 2018; Siddaway et al., 2015) there

has been contention over the conceptualisation of perceptions of entrapment. This

psychological construct is most commonly assessed using a self-report measure

called The Entrapment Scale (Gilbert & Allen, 1998). Entrapment was initially

described as having two subcomponents (internal and external) based on the

proposal that both internal and external processes could trigger, exacerbate and maintain perceptions of feeling trapped (Gilbert, 1992). More specifically, internal entrapment refers to feeling trapped by internally derived thoughts and feelings, whereas external entrapment is proposed to refer to a perceived inability to escape undesirable life circumstance in the outside world. However, subsequent research has demonstrated inconsistent results regarding the factor structure of this construct. While some research suggests that entrapment may be a unidimensional construct (Tucker et al., 2016), more recent cross-cultural work provides support for the bi-dimensional nature of entrapment (i.e., that internal and external entrapment are distinct but inter-related subcomponents that should be assessed separately) (Cramer et al., 2019). Further, a body of evidence is emerging to suggest that internal entrapment is more robustly associated with suicidal thoughts and behaviours than external entrapment in adults (Cramer et al., 2019; De Beurs et al., 2019; Owen et al., 2018). This pattern of findings provides an important insight into the suicidal process by demonstrating that the perception of being unable to escape one's own thoughts and feelings is more closely linked to the development of suicidal ideation and attempts than the feeling of trapped by external events or circumstances. Moreover, these results reinforce the assertion that individuals may attempt to take their own lives as a consequence of perceiving suicide as a solution to escaping the unbearable psychological pain that they are experiencing.

Despite adolescents representing a high-risk group for self-harming and suicidal thoughts and behaviours, entrapment has received limited attention within in this population (Park et al., 2010). Consequently, the factor structure of the Entrapment Scale has not yet been determined in young people and it is not clear if entrapment is best conceptualised as a unidimensional or bidimensional construct

during this developmental period. This knowledge is necessary to meaningfully inform future research regarding perceptions of entrapment in this population and, beyond benefiting the research community, the insights provided from an examination of the factor structure of this instrument will have implications for measurement, theory and practice.

In terms of the research presented in the current thesis, exploring entrapment in young people, and considering how it should be measured, will help to refine understanding of the role of this psychological construct within the pathway from sleep disturbance to self-harming thoughts and behaviours. Despite most research supporting a two-factor structure of the entrapment scale, previous research in adults has focused on examining interrelations between sleep problems, suicidal ideation and *total* entrapment (i.e., as a unidimensional factor) (Littlewood et al., 2017). If it is the case that entrapment is best conceptualised as bidimensional within an adolescent population, investigating internal and external entrapment separately will provide a more nuanced understanding of the psychological pathways underpinning the link between sleep disturbance and self-harm risk. As such, there is a need to establish the factor structure of entrapment specifically within an adolescent population.

Moreover, although perceptions of defeat are a core construct within self-harm pathways, they have received limited attention during adolescence and it is not yet clear whether the Defeat Scale (Gilbert & Allen, 1998) has adequate psychometric properties in adolescent samples, and whether the one factor structure reported in adults is a good fit to data collected from young people. This understanding is necessary if we are to better comprehend the role of defeat within the association

between sleep and self-harm risk, and will benefit future research investigating defeat as a driver of self-harm risk more broadly.

5.2.3 The current study

Whilst the findings presented in Chapter 4 demonstrated that sleep problems predicted future self-harm behaviours. It is not yet clear *why* this relationship exists. Therefore, the overarching aim of the present study was to test predictions, derived from the IMV, in order to advance understanding of the psychological mechanisms linking sleep disturbance and thoughts of self-harm in adolescents across a six-month prospective period. An investigation of this nature first requires that the factor structures of key measured are established. Given that Chapter 4 demonstrated insomnia symptoms to be the only independent predictor of self-harm thoughts, the current investigation will focus specifically on this aspect of sleep disturbance.

More specifically this study aimed to:

1. Examine the psychometric properties and factor structures of the Defeat Scale and Entrapment Scale within an adolescent sample. These factor solutions will be used to guide the analytical approaches taken to address the second and third aim of this investigation.
2. Investigate differences in levels of defeat and entrapment between adolescents with and without clinically salient insomnia symptoms.
3. Test hypothesised multi-step pathways derived from the IMV which link insomnia symptoms (as a potential pre-motivational factor) and prospective self-harm thoughts, via perceptions of defeat and entrapment (Figure 5.2).
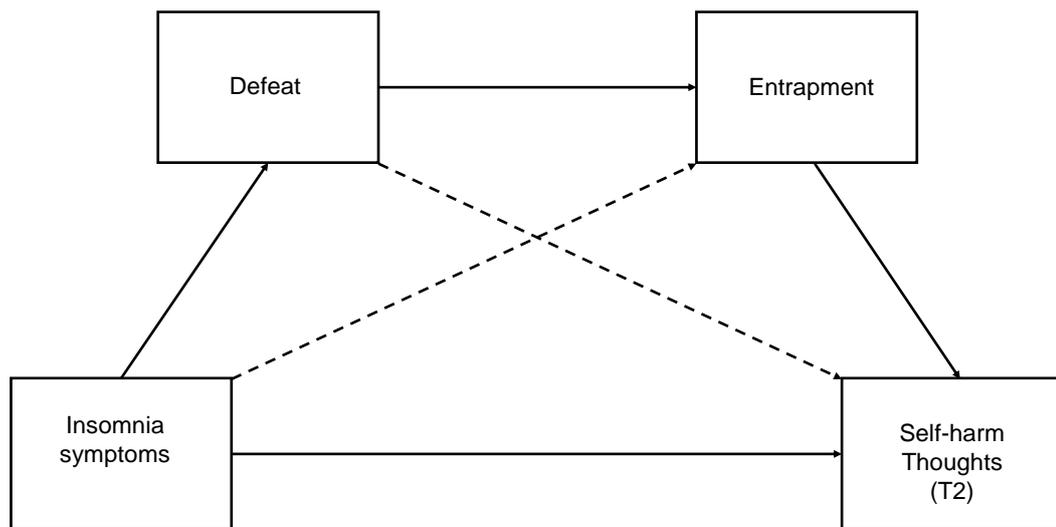
Figure 5. 2. Predicted serial multiple mediation pathway (highlighted in non-dashed lines) for association between insomnia symptoms and prospective self-harm thoughts, via defeat and entrapment. Predicted multiple mediation pathway highlighted in non-dashed lines

Three hypotheses were generated. First, based on previous research in UK-based adults, it is hypothesised that a two-factor (i.e., internal and external) structure of the Entrapment Scale will be supported expected that support will be generated for a one-factor structure for the Defeat Scale. Second, it was expected that adolescents experiencing sleep problems would report elevated perceptions of both defeat and entrapment. Third, based on previous research in adults (Littlewood et al., 2016b), it was hypothesised that the prospective association between subjective sleep disturbances and one's intention to engage in self-harm, would be linked via an indirect pathway. Specifically, it was predicted that sleep problems would be linked to defeat, defeat would be associated with entrapment, and entrapment would be related to future thoughts of self-harm. Given that no previous research has examined specific subtypes of entrapment (i.e., internal and external) within this context, no predictions were made with regards to whether findings would differ according to entrapment subscales.

5.3. Methods

The work presented in this chapter is based on further analysis of data collected during the school-based survey introduced in Chapter 4. Where information has already been provided, reference will be made to specific subsections to avoid unnecessary duplication. Measures and data analytic procedures that have not yet been described (and are relevant to the novel research aims of the current chapter) will be detailed in subsections 5.3.2 and 5.3.4.

5.3.1. Participants

An overview of participant socio-demographic characteristics is provided in Chapter 4 (Subsection 4.3.1).

5.3.2. Measures

The measures implemented to assess insomnia symptoms, depressive symptomology, and thoughts of self-harm are detailed in Chapter 4 (Subsection 4.3.2).

Defeat. The Defeat Scale (Gilbert & Allan, 1998) is a 16 item measure that assesses an individual's feelings of defeat (i.e., perceived failed struggle and loss of social rank). Respondents indicate on a 5-point scale (ranging from 0 = "Never" to 4 = "Always") the occurrence of these perceptions. Scores for each item are combined to create a total continuous score with higher scores indicating greater levels of defeat (Range = 0 to 64). Internal consistency was excellent in this sample at baseline (α = .95) and follow up (α = .89).

Entrapment. Perceptions of being trapped were assessed using the 16-item Entrapment Scale (Gilbert & Allan, 1998) (e.g., I have a strong desire to escape from

things in my life). The measure consists of two subscales: internal entrapment (perceptions of entrapment by one's own thoughts and feelings: e.g., 'I feel trapped inside myself'; 6 items) and external entrapment (perceptions of entrapment by external situations: e.g., 'I feel trapped by other people'; 10 items). Respondents rate the extent to which each item describes their feelings on a five-point scale that ranges from 0 to 4 ("Never" to "Always"). Responses to each item are combined to create a total score, which can range from 0-64. Higher scores indicate greater levels of entrapment. Internal consistency for total entrapment (α = .96), internal entrapment (α=0.91), and external entrapment (α = 0.94) were excellent at baseline and at the six-month follow up.

5.3.3. Procedure

Details of this study procedure are described extensively in Chapter 4 (Subsection 4.3.3).

5.3.4. Data analytic strategy

In order to examine the psychometric properties of the Defeat Scale (and determine its suitability for the remainder of the analyses within the present investigation) confirmatory factor analysis (CFA) was conducted using AMOS 26. A one factor model was run. In order to examine the factor structure of the Entrapment Scale (and guide the conceptualisation of entrapment for the remainder of the analyses within the current investigation) CFA was conducted using AMOS 26. Two models were compared: a one factor (i.e., total entrapment) and two-factor (i.e., internal and external entrapment) model. Given that previous literature has demonstrated strong associations between internal and external entrapment (Tucker et al., 2016; Cramer et al., 2019), latent variables for both entrapment subtypes were allowed to correlate within the two-factor model. Interpretation of fit indexes (for both

defeat and entrapment models) was guided by established recommendations in the statistical literature (Kline, 2011; Schmitt, 2011) and a recent examination of the Entrapment Scale factor structure in young adults (Cramer et al., 2019).

IBM SPSS Statistics 25 for Windows (IBM Corp, Armonk, NY, USA) was used to conduct all remaining statistical analyses. Given that both the self-harm intention groups *and* sleep disturbance groups were unequal (and that the assumption of homogeneity was violated (for depression, defeat and entrapment) bootstrapping was applied in all analyses (beyond the CFA). In this study, analyses were based on 5000 sample bootstrap replications. Initially, Pearson product-moment correlational analyses were conducted to allow for a preliminary examination of the interrelationships between all variables assessed within the study.

Three separate ANCOVA analyses were conducted in order to examine differences in perceptions of defeat and entrapment in young people with and without clinically salient symptoms of insomnia. Based on the results of our factor analysis, entrapment was divided into its respective internal and external subscales. The severity of depressive symptoms and previous experience of self-harm thoughts were included as planned covariates. To control for the number of comparisons we employed Holm's sequential Bonferroni correction method throughout.

Next, a serial multiple mediation pathway was tested using model 6 of the PROCESS algorithm for SPSS (Hayes et al, 2013) whereby the relationship between clinically salient sleep disturbances and prospective self-harm thoughts was mediated by perceptions of defeat and entrapment at baseline. Two separate mediational models were run. In the first model, the predictor variable was insomnia symptoms, the mediator variables were perceived defeat and internal entrapment,

and the outcome variable was self-harm thoughts. The analysis controlled for the presence of depressive symptomology as well as history of self-harm thoughts on both the outcomes and mediators. This analysis was repeated, replacing internal entrapment with external entrapment. As both subtypes of entrapment are highly correlated, where internal entrapment was entered as a mediator we included external entrapment as a covariate and vice versa. Direct and indirect effects were calculated for both models. Given that PROCESS expects complete data on all variables included in the model, and that 7 participants (1.3%) had missing data, these analyses were conducted using 98.7% of the original sample (n=566). Missing data were handled using listwise deletion. Prior to testing all hypotheses, multicollinearity was assessed using tolerance statistics and the variance inflation factor (VIF). No issues were found.

When study designs are complex (as in the case of serial multiple mediation models) traditional power calculation analyses are deemed to be inappropriate. Monte Carlo simulations are considered best practice for estimating power and sample sizes (Shoemann, Boulton, & Short, 2017) under these circumstances. Using the R shiny app "Monte Carlo Power Analysis for Indirect Effects" (within the R studio development environment (R Studio Team, 2018)) it was determined that a minimum sample of 960 participants was required to achieve the desired level of power (0.80) to detect a small effect size.

5.4. Results

5.4.1. Preliminary analyses

As reported in Chapter 4 (subsection 4.4.1),16.2% (n=92) of the adolescents who completed the survey at both time points had thought about self-harm during the six-month follow up period. Descriptive statistics (for all continuous variables) and correlational analyses (for all study variables) are presented in Table 5.1. Associations between all variables were positive and statistically significant.

Table 5. 1. Means, standard deviations and Pearson product-moment correlational coefficients for insomnia, depression, defeat, internal entrapment, external entrapment and self-harm thoughts.

	1	2	3	4	5	6	7
1. Insomnia symptoms							
2. Depressive symptoms	.252***						
3. Defeat	.313***	.534***					
4. Internal Entrapment	.345***	.511***	.779***				
5. External Entrapment	.333***	.458***	.716***	.958***			
6. SHT T1	.338***	.317***	.510***	.596***	.531***		
7. SHT T2	.250***	.191***	.342***	.335***	.337***	.308***	
Median	-	3.00	11.00	1.00	2.00	-	-
Interquartile range	-	4.00	17.00	6.00	8.00	-	-

Note, Variables 1 to 5 within the correlation matrix were collected at baseline, SHT T1 = Lifetime history of Self-Harm Thoughts, SHT T2 = Self-Harm Thoughts during 6 month follow up. ***p <.001. Where variables are dichotomous the symbol (-) indicated that it was not possible to calculate a median and interquartile range.

5.4.2. Does defeat have a unidimensional structure in adolescents?

Model fit statistics are presented in Table 5.2. The one factor-model demonstrated adequate fit based on a) CFI and TLI (i.e., >0.90) and b) RMSEA (i.e., <0.10). Factor loadings for defeat (λ range = 0.56 to 0.86, all p values < .001) were all significant and positive. Consequently, it was determined that a unidimensional conceptualisation adequately captures defeat in adolescents and that the Defeat Scale has adequate psychometric properties when employed in a sample of young people.

Table 5. 2. Defeat scale confirmatory factor analysis (CFA) model fit statistics

	X^2 (df), p-value	X/df	CFI	TLI	RMSEA (90% CI)
One factor	1099.44 (103), p<0.001	10.57	.924	.902	.09 (.09,10)

Note, df = Degrees of freedom; CFI = Comparative fit index; TLI = Tucker–Lewis Index; RMSEA = Root mean square error of approximation

5.4.3. Is entrapment best conceptualised as a unidimensional or bidimensional construct in adolescents?

Model fit statistics for both one and two Entrapment Scale factor structure solutions are presented in Table 5.3. Based on a) CFI (i.e., >0.90), b) RMSEA (i.e., <0.10) and, c) BIC (i.e., higher for the one factor structure), the two-factor model demonstrated better fit compared to the one factor alternative solution. Factor loadings for internal (λ range = 0.34 to 0.86, all p values < .001) and external entrapment (λ range = 0.72 to 0.86, all p values < .001) were all significant and positive. Whilst this was also the case with regards to the factor loadings for the one

factor structure, the correlation coefficients for each item were lower overall (λ range = 0.12 to 0.72) relative to those calculated when testing the two-factor structure model. This suggests that there is a weaker relationship between each of the items and the underlying uni-dimensional factor structure. As a rule of thumb, factor loadings of 0.7 or higher represent that the factor extracts sufficient variance from that item. Only one third of the entrapment items reached this threshold (n=5). Conversely, fifteen of the items had factor loadings greater that 0.7 when testing the two-factor structure model. Consequently, it was determined that a bidimensional conceptualisation best captured entrapment in adolescents and the two-factor solution was retained for further analyses in the current investigation. The factor loadings for individuals items in relation to the the one and two-factor structure models are presented in Appendix J.

Table 5. 3. Entrapment scale confirmatory factor analysis (CFA) model fit statistics

	X^2 (df), p-value	X/df	CFI	TLI	RMSEA (90% CI)	BIC
1. One factor	1351.77 (104), p<0.001	12.99	.912.	.884	.11 (.10,12)	1449.35
2.Two factor	1254.44 (103), p<0.001	12.17	.918	.892	.09 (.09,11)	1354.06

Note, df = Degrees of freedom; CFI = Comparative fit index; TLI = Tucker–Lewis Index; RMSEA = Root mean square error of approximation; BIC = Bayesian Information Criterion

5.4.4. Do adolescents with and without clinically salient sleep disturbances differ in perceptions of defeat and entrapment?

ANCOVA analyses were conducted to address the second aim of the study. As demonstrated in Table 5.4., feelings of defeat (F (1, 572) = 24.04, p<0.001; η p2 = 0.43), internal entrapment (F (1, 572) = 16.37, p<0.001; η p2 = 0.42) and external entrapment (F (1, 572) = 11.15, p<0.001; η p2 = 0.33) were elevated in young people with clinically salient insomnia symptoms relative to those not reaching the clinical threshold for probable insomnia disorder. These findings demonstrate that differences between groups, in terms of perceptions of defeat and entrapment, were large when comparing young people with and without clinically salient sleep disturbances (and statistically adjusting for depressive symptoms and history of self-harm thoughts).

Table 5. 4. Perceptions of defeat and entrapment in young people with and without probable insomnia disorder.

	Insomnia Disorder Symptoms	
	Present	**Absent**
Total defeat	30.00 (26.00)[a]	10.00 (14.00)[a]
Internal entrapment	10.50 (12.75)[a]	1.00 (4.00)[a]
External entrapment	10.50 (14.50)[a]	1.00 (6.00)[a]

[a] Row comparison significantly different, p < .001. The severity of both depressive symptomology and history of self-harm thoughts was controlled for within each of the four separate ANCOVA analyses. All significant results survived Holm's sequential Bonferroni correction.

5.4.5. Do perceptions of defeat and entrapment mediate the relationship between insomnia symptoms and self-harm thoughts?

The direct pathways between clinically significant insomnia symptoms, defeat, internal entrapment and self-harm thoughts (controlling for depression and previous self-harm thoughts) are presented in Figure 5.3. Unstandardised point estimates and

bootstrapped 95% CI for the total indirect effect and three specific indirect pathways

are provided in Table 5.5.
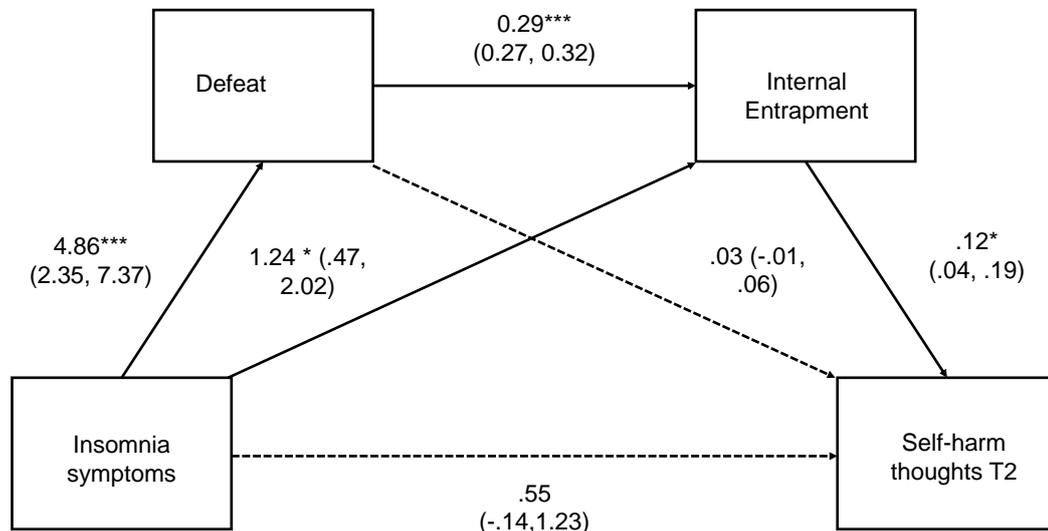
Figure 5. 3. Serial multiple mediation model for the association between insomnia symptoms and subsequent self-harm, via defeat and internal entrapment.

*p<0.05, **p<0.01, ***p<0.001 Serial multiple mediation model with unstandardized regression coefficients and 95% bias corrected confidence intervals. Significant pathways are highlighted in bold.

Insomnia symptoms were significantly associated with prospective self-harm

thoughts indirectly through defeat and internal entrapment at baseline. Insomnia

symptoms, defeat and internal entrapment explained a moderate amount of the

variability in the likelihood of reporting self-harm thoughts (Pseudo R^2; Cox and Snell

= .15, Nagelkerke = .27; McFadden = .19). Insomnia symptoms did not maintain a

significant direct relationship (p=.117) with future self-harm thoughts within the full

mediational model, demonstrating that defeat and internal entrapment account for

the relationship between insomnia and prospective thoughts of self-harm.

Table 5. 5. Point estimates for indirect effects and 95% bias corrected confidence intervals for serial multiple mediation analysis in which defeat, and internal entrapment (I) were represented as mediators in the association between insomnia and self-harm thoughts (controlling for depression, history of self-harm thoughts and external entrapment)

Mediation Path	Point Estimate	95% confidence intervals [a]	
		Lower	Upper
Insomnia > Defeat > SHT	.14	-.03	.35
Insomnia >Entrapment (I) > SHT	.14	.02	.34
Insomnia > Defeat >Entrapment (I) > SHT	.16	.03	.37
Total indirect effect	.44		

a Statistical significance indicated by confidence intervals not containing 0.

The direct pathways between clinically significant insomnia symptoms, defeat, external entrapment and self-harm thoughts, controlling for depression and previous self-harm thoughts, are presented in Figure 5.4. Unstandardised point estimates and bootstrapped 95% CI for the total indirect effect and three specific indirect pathways are provided in Table 5.6.
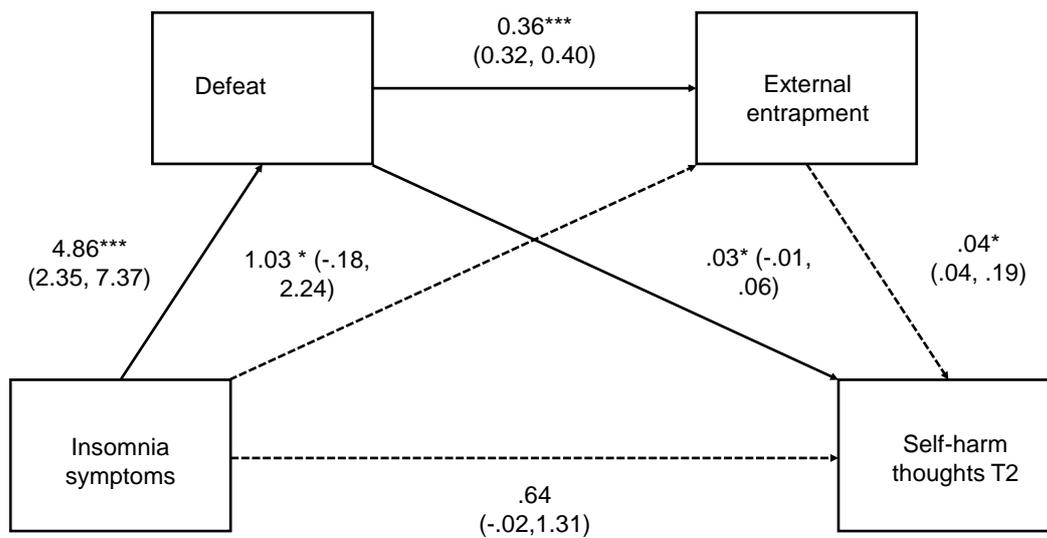
Figure 5. 4. Serial multiple mediation model for the association between insomnia symptoms and subsequent self-harm thoughts, via defeat and external entrapment.

*p<0.05, **p<0.01, ***p<0.001 Serial multiple mediation model with unstandardized regression coefficients and 95% bias corrected confidence intervals. Significant pathways are highlighted in bold.

Insomnia symptoms were significantly associated with prospective self-harm thoughts indirectly through defeat. Here, the mediational pathway from insomnia symptoms to prospective self-harm thoughts, through defeat and external entrapment, was not significant. Insomnia symptoms, defeat and external entrapment explained a moderate amount of the variability in the likelihood of reporting self-harm thoughts (Pseudo R2; Cox and Snell = .15, Nagelkerke = .26, McFadden = .18). Insomnia symptoms did not maintain a significant direct relationship (p=.059) with future self-harm thoughts within the full mediational model, demonstrating that within this model defeat accounted for the relationship between insomnia and prospective thoughts of self-harm. Within this serial mediation model, insomnia was not significantly associated with external entrapment (p= 0.10), and

the pathway from insomnia to self-harm thoughts via external entrapment was not

significant.

Table 5. 6. Point estimates for indirect effects and 95% bias corrected confidence intervals for serial multiple mediation analysis in which defeat, and external entrapment (E) were represented as mediators in the association between insomnia and self-harm thoughts (controlling for depression, history of self-harm thoughts and internal entrapment)

		95% confidence intervals [a]	
Mediation Path	**Point Estimate**	**Lower**	**Upper**
Insomnia > Defeat > SHT	.23	.05	.49
Insomnia >Entrapment (E) > SHT	.04	-.03	.15
Insomnia > Defeat >Entrapment (E) > SHT	.07	-14	.19
Total indirect effect	.35		

a Statistical significance indicated by confidence intervals not containing 0.

5.5. Discussion

The current study is the first to examine the psychometric properties of the

Defeat Scale and the factor structure of the Entrapment Scale within an adolescent

sample. In addition, it is the first investigation to prospectively test predictions,

derived from the IMV, in order to advance understanding of the psychological

mechanisms linking symptoms of adolescent sleep disturbance and future self-harm

risk in adolescents. The aims of the current study were threefold. First, in order to

expand our understanding of defeat and entrapment in young people, and to

determine whether entrapment is best conceptualised as an overarching factor, or a

construct with two subcomponents (i.e., internal or external entrapment), we set out

to examine the factor structure of the of the Defeat Scale and Entrapment Scale. Second, we sought to investigate differences in perceptions of defeat and entrapment between adolescents with and without clinically salient sleep disturbances. Third, we wished to test hypothesised multi-step pathways linking sleep disturbance and self-harm thoughts, via perceptions of defeat and entrapment (internal or external).

5.5.1. Exploring perceptions of defeat and entrapment during adolescence

Research in adults has emphasised the role of defeat within self-harm pathways (Littlewood et al., 2016b; Rasmussen et al., 2010; Siddaway et al., 2015). However, this psychological construct has received limited attention during adolescence. The findings of our confirmatory factor analyses demonstrated that the one factor structure reported in adults is an adequate fit to data collected in young people but that it could operate better. This suggests that defeat is best conceptualised as a unified construct during adolescence, but that future work should focus on refining the measure in order that it performs better in this population.

Entrapment has received substantial research attention and is central to theoretical conceptualisations of suicide and self-harm (O'Connor & Portzky, 2018b; O'Connor & Kirtley, 2018). However, gaps in knowledge regarding this psychological construct remain. For example, only one investigation has measured entrapment during adolescence (Park et al., 2010), and it is not clear how it should be conceptualised in this population. The findings of our confirmatory factor analysis support a two-factor structure of the Entrapment Scale, and corroborate previous work conducted with young adults in the UK (De Beurs et al., 2019; Cramer et al.,

2019). In providing preliminary evidence for a bidimensional conceptualisation of entrapment, our results provide a rationale for considering internal and external entrapment separately. As this is the first study to examine the nature of entrapment, future replication is necessary, and should take place cross-culturally in order to capture any culturally driven distinctions. For example, recent work from Cramer et al. (2019) provides novel insights into cross-cultural differences between young adults from the UK and the US. More specifically, Research of this nature in adolescent samples will help to refine psychological models of suicide and self-harm (e.g., the IMV, O'Connor & Kirtley, 2018).

5.5.2. Mechanisms linking insomnia symptoms and self-harm thoughts: The role of defeat and entrapment

Large differences in feelings of defeat and entrapment were observed between individuals with clinically salient sleep complains and those without. These findings support our second hypothesis. Specifically, young people endorsing symptoms of insomnia reported elevated perceptions of defeat and entrapment. These findings were consistent across both entrapment subscales (i.e., internal and external). This is the first study to investigate these self-harm related constructs overall, and in relation to insomnia, within an adolescent population. Further, this investigation builds on previous research by examining entrapment subtypes separately, for the first time, within the context of the sleep-self-harm link.

The present study provided support for the hypothesised multi-step mediational pathway as results of the serial mediation analysis suggest that insomnia symptoms are associated with defeat, defeat is linked to internal entrapment, and feeling trapped is related to future self-harm thoughts. These findings demonstrate that previous findings (Littlewood et al., 2016b) highlighting that

defeat and entrapment account for the link between nightmares and suicidal ideation, extend to self-harm thoughts more broadly (and prospectively), and are also relevant to other sleep disturbances. However, our findings extend previous work by examining the role of specific dimensions of entrapment within this context for the first time and highlighting the importance of internal (but not external entrapment). Our work offers novel insights regarding the link between sleep disturbances and self-harm thoughts and reinforce the importance of defeat and entrapment as potentially transdiagnostic psychological constructs underlying self-harm thoughts and behaviours (Owen et al., 2018; Griffith et al., 2014; Siddaway et al., 2015; O'Connor & Portzky, 2018). This is particularly interesting as the relationship between defeat, entrapment, and self-harming thoughts (with and without suicidal intent), has never been scientifically tested in a sample of adolescents.

The current study aimed to advance understanding regarding the role of entrapment within the relationship between insomnia symptoms and prospective self-harm thoughts. Previous research has focused on total entrapment. However, given the results of our factor analysis, we aimed to elucidate the effects of each subtype of entrapment by dividing the entrapment measure into its respective subscales (internal and external entrapment) and investigating their influence separately. Results demonstrated that internal entrapment mediated the relationship between perceptions of defeat, which had been triggered by insomnia symptoms, and self-harm thoughts. However, external entrapment did not. These findings provide a more refined understanding of this relationship than the existing evidence base. More specifically, our results suggest that young people's perceptions of being unable to escape their thoughts and feelings account for the relationship between

defeat and thoughts of self-harm. As this is the first prospective study to examine the role of defeat and entrapment within the sleep-self-harm link, replication is important.

By highlighting the importance of internal entrapment (but not external entrapment) our findings are in line with recent findings which have highlighted that perceiving one's thoughts and feelings to be inescapable is a critical component in understanding the pathway to self-harm and suicide (i.e., De Beurs et al., 2019). Our results demonstrate that young people who experience difficulties initiating and/or maintaining sleep (which characterise insomnia) may feel unable to escape intrusive negative cognitions and emotions. Self-harm may then be considered by adolescents as a source of relief, or a way to escape this psychological pain.

5.5.3 Establishing the nature of the link between insomnia, defeat and entrapment

Within the current investigation, experiencing clinically salient insomnia symptoms was related to increased perceptions of defeat. However, it is not yet clear why this association exists. As a result, future research seeking to disentangle the nature of this link is warranted. Impairments in daytime functioning and quality of life are salient consequences of experiencing insomnia (Kyle et al., 2013). It is possible that perceptions of defeat could arise in response to this daytime dysfunction. Research conducted by Kyle, Espie and Morgan (2010), employing focus groups and audio diaries, has demonstrated that adults experiencing chronically disturbed sleep report daily difficulties with cognitive, emotional, interpersonal and physical functioning. The impairments were cumulatively reported to be associated with compromised social functioning, feeling like an outsider, the notion of struggling through the day, and reduced quality of life. Taken together these experiences could be conceptualised as "defeating". This is the case as perceptions of defeat are

negative self-appraisals that are characterised by one's sense of failure, and insomnia is often seen as contributing to individual's failure to becoming their "desired self" (Kyle et al., 2010). Insomnia is viewed as an obstruction or a barrier here because of its pervasive impact on daily functioning, and because it is perceived to prevent individuals from achieving goals that would be otherwise obtainable if they were good sleepers.

Findings from a recent qualitative interview study (Littlewood et al., 2017) exploring narrative accounts of the role of sleep in relation to suicidal thoughts and behaviours, reinforced the defeating nature of poor sleep. Participants highlighted that a failure to achieve good sleep was associated with reduced mental strength and resources, and poor sleep was perceived to make life harder. It is also possible that young people experiencing insomnia may feel "defeated" as a result of their perceived inability to control or predict their sleep-wake schedules (Morin, Vallières, & Ivers, 2007), or due to the repetitive negative intrusive thoughts that are a hallmark feature of insomnia (Harvey, 2015). These thoughts may be perceived as more defeating as a result of interpretational biases (i.e., catastrophising), judgement biases (i.e., lack of control over emotions) and negative attribution styles (i.e., global attributions for the occurrence of negative events) that are apparent in individuals experiencing sleep disturbances (Blake, Trinder, & Allen, 2018).

However, it is important to note that most of this research has been conducted exclusively in adult samples. Given that adolescence is a distinct developmental period, associated with developmentally specific biological, cognitive, social and psychological demands, findings from adult populations should be applied to young people with caution. Future research should examine the daytime impact of insomnia

in adolescent samples and seek to determine why sleep disturbance could be perceived as defeating in nature.

As well as highlighting a link to perceptions of defeat, our findings also demonstrated that insomnia symptoms were directly related to internal entrapment (but not total or external). These results suggest that these clinically salient symptoms are linked to the perception that thoughts and feelings are inescapable in young people. Future research should seek to obtain a more fine-grained understanding regarding the nature of this relationship. Investigations, which seek to understand why insomnia symptoms and internal entrapment are related, may benefit from a theoretical integration with models of insomnia (e.g., the Cognitive Model of Insomnia). For example, worry and rumination play an important role in maintaining insomnia (Harvey, 2000). These cognitions are intrusive and may be perceived as inescapable by young people who will struggle to divert themselves away from or distract themselves from these negative thoughts when lying awake at night. Further, insomnia symptoms are associated with deficits in emotional regulation (Palmer, Oosterhoff, Bower, Kaplow, & Alfano, 2018), which may lead young people to feel trapped by and unable to control their feelings. This is particularly important given that young people often cite an affective regulation function of their self-harm (Klonsky, 2007).

Taken together, these findings provide preliminary evidence to suggest that insomnia may confer increased risk for future self-harm thoughts in young people, and that increased perceptions of defeat and internal entrapment may account for this relationship. On the basis of the IMV we hypothesised that sleep problems may act as a stressor or induce stress, which contributes to perceptions of defeat: defeat then is associated with entrapment, and entrapment is linked to self-harm ideation.

234

Findings provided support for this hypothesised pathway. For the first time, we provide preliminary evidence for the role of defeat and internal entrapment in driving the link between sleep disturbance and self-harm thoughts in young people. Finally, our findings reinforce the argument that the IMV is a useful framework for examining the relationship between sleep problems and self-harm thoughts.

5.5.4. Strengths and Limitations

The key strengths and limitations of the current investigation were discussed in detail in Chapter 4. However, one additional limitation is particularly relevant to the results presented within the current chapter. Whilst the current investigation is prospective in nature, there were only two waves of data collection. As a result of overlapping time periods in the assessment of some variables, it was not possible to determine temporal precedence with regards the multi-step mediational pathway linking sleep problems and self-harm thoughts (Wilner et al., 2016). Therefore, it is not possible to rule out alternative causal pathways. For example, we cannot form clear conclusions regarding the directionality of the link between insomnia symptoms and internal entrapment. It could be that perceiving thoughts and feelings as inescapable contributes to difficulties sleeping, or the relationship may be bidirectional. Future research applying multi-wave longitudinal cohort designs, would allow for an enhanced understanding of how processes unfold over time during adolescence. Further, micro-longitudinal investigations, such as daily diary studies or work implementing experience sampling methodologies, would allow for a more high-resolution examination of the relationship between these variables in daily life.

5.5.5. Implications

The findings of the current investigation have implications for future research. We conducted the first examination of the factor structure of the Entrapment Scale in young people. Our findings provide preliminary evidence to suggest that future work with young people should employ a bidimensional conceptualisation of entrapment in order to obtain a more nuanced understanding regarding the pathways to self-harm risk. This knowledge is also critical for refining psychological theories and developing effective interventions. Whilst our findings do advance understanding, many questions remain unanswered. Therefore, an important next step will be to conduct investigations that take the dynamic nature of sleep and self-harm risk (thoughts and behaviour) into consideration. The research presented in Chapters 4 and 5, have provided novel insights into the relationship between symptoms of sleep disturbance and self-harm, and provided a foundation that future research can build upon using novel and innovative techniques. Research employing these methodologies will also advance understanding regarding adolescents' experiences of defeat and entrapment in daily life, and the role of these psychological mechanisms in the short-term prediction of self-harming thoughts and behaviours. Further, mixed-method approaches, which incorporate the narratives of individuals with lived experience, will provide valuable information about the nature of entrapment across the lifespan, as well as providing key insights into the relationship between sleep problems, entrapment and self-harm.

In terms of theory, the findings of the current investigation provide preliminary evidence to suggest that insomnia symptoms could be a candidate factor for inclusion in the pre-motivational phase of the IMV, and therefore could be conceptualised as a vulnerability/background factor. Further reinforcement for this

proposal can be taken from the fact that the diathesis-stress model of insomnia (Spielman, Caruso, & Glovinsky, 1987) maps directly onto the diathesis-stress conceptualisation of the pre-motivational phase. Similar to the IMV, the diathesis stress-model of insomnia proposes that the sleep disorder results from an interaction between background factor and triggering events.

In addition, the findings presented in the previous chapter suggest that different dimensions and symptoms of sleep disturbance may contribute at self-harm risk, at different phases throughout complex pathway to self-harm behaviour. That is the case as sleep quality was an independent predictor of self-harm acts, but not thoughts. This would mean that psychological mechanisms are not uniform across sleep problems. Future research should investigate the role of sleep quality as a potential motivational moderator in adolescents, and consider the position of other symptoms of sleep-disturbance within the IMV. No research has explicitly investigated whether sleep problems distinguish between young people who think about self-harm and young people who engage in self-harm behaviour. Research of this nature would have important implications in terms of theory and practice.

With regards to theoretical conceptualisations of suicide and self-harm, the findings presented are relevant to recent attempts to characterise the acute mental state that precedes a suicide attempt. A growing body of evidence supports the existence of an acute suicide crisis syndrome (Rogers, Galynker, Yaseen, DeFazio & Joiner, 2017; Schuck, Calati, Barzilay, Bloch-Elkouby & Galynker, 2019), and highlights the central role of entrapment within this mental state (Li et al., 208). Moreover, entrapment explains the association between other suicide crisis syndrome symptoms and suicidal thoughts and behaviours (Li et al., 2018). Our work provides novel insights into the conceptualisation of entrapment in young people and

provides support for a two-factor structure of the Entrapment Scale in this population. These findings are relevant to the conceptualisation of suicide crisis syndrome in adolescents and suggest that future work in this area should aim to obtain a more nuanced understanding of the role of both specific components of entrapment within this context. This knowledge is necessary as the perception of being trapped appears to be a key target for the identification and treatment of those who are acutely suicidal.

The current investigation examined the link between sleep and self-harm thoughts within the context of a theoretical framework. Our findings could have implications for the evaluation and management of self-harm. For example, the present study suggests that defeat and internal entrapment may be useful indicators of self-harm risk in young people experiencing insomnia symptoms. In particular, perceptions of internal entrapment could be a useful target for assessment, prevention and intervention in adolescent populations (within both community and clinical settings). Insomnia symptoms, as well as perceptions of defeat and entrapment, offer modifiable interventions for psychosocial interventions to target. Future research should seek to establish if targeting insomnia symptoms in young people is associated with diminished feelings of defeat and entrapment, and a lower risk of self-harm thoughts. Investigations of this nature are warranted as current interventions, which targeting thoughts of self-harm, are largely ineffective (Jobes & Joiner, 2019), and many more young people think about harming themselves than go on to do so. Interventions that contribute to a decrease in young people thinking about self-harm would be meaningful in themselves given the distress associated with these thoughts. Moreover, it has been considered that a reduction in self-harm

ideation could delay behavioural events and may lead to fewer acts of self-harm downstream (Jobes & Joiner, 2019).

Our findings extend the existing literature and provide valuable insights into the role of specific sleep complaints in self-harm pathways during adolescence. However, there is a pressing need for research which accounts for the fluctuating nature of sleep disturbance as well as self-harm thoughts and behaviours. Further, investigations which explore the role of defeat and entrapment in daily life are necessary to progress our understanding of the role of psychological factors within the sleep-self-harm link.

5.6. Key points from Chapter 5:

1. Entrapment is best conceptualised as a bidimensional construct in adolescents. Therefore, researchers should measure entrapment using individual subscales (i.e., internal and external entrapment) when investigating this population.

2. Adolescents reporting clinically significant insomnia symptoms endorsed elevated perceptions of defeat, internal entrapment, and external entrapment.

3. The results of serial multiple mediation analyses supported the hypothesised pathway from insomnia symptoms to self-harm thoughts. More specifically, insomnia symptoms were associated with defeat, defeat was linked to internal entrapment, and internal entrapment predicted prospective self-harm thoughts. The important role of internal entrapment within this relationship suggests that insomnia symptoms may be associated with the perception that young people are unable to escape negative thoughts and emotions. This perception in turn increases self-harm risk.

5.7. Next steps:

1. The research presented in Chapters 4 and 5 provides novel insights regarding the link between sleep disturbance and self-harm in young people. However, the research design that was implemented, does not account for the dynamic nature of sleep disturbance, defeat, entrapment, and self-harmful thoughts and behaviours over time. Chapter 6 will investigate whether symptoms of sleep disturbance predict self-harm thoughts and behaviours the next day using a novel micro-longitudinal daily diary research design. This methodology also provides the opportunity to examine defeat and entrapment, and their role within the sleep-self-harm link, in daily life.

Chapter 6: Examining the link between symptoms of sleep disturbance, self-harm risk and psychological factors in adolescents' daily lives: A micro-longitudinal investigation

6.1. Chapter Overview

The results presented in Chapter 4 highlight that symptoms of sleep disturbance predict self-harm risk over a period of six months. More specifically, young people reporting clinically salient symptoms of insomnia were more likely to think about or engage in self-harm (irrespective of intent and motivation) than those without this sleep problem. Moreover, poor subjective sleep quality was also associated with increased risk of self-harm behaviour. Chapter 5 advanced understanding regarding the interrelationships between sleep disturbance, self-harm risk and theoretically salient risk factors. Notably, perceptions of defeat and internal entrapment mediated the link between insomnia symptoms and subsequent self-harm thoughts. However, limited information is available about the extent to which symptoms of sleep disturbance and perceptions of defeat and entrapment are associated with self-harm risk in the short term. The current investigation is the first micro-longitudinal examination of these relationships within the context of adolescents' daily lives.

Ninety-seven adolescents completed brief surveys twice a day for a period of seven days. Information regarding subjective sleep parameters and symptoms of sleep disturbance were captured each morning using a prospective sleep diary. Self-harm thoughts, self-harm behaviours, depressed mood, and perceptions of defeat and entrapment were assessed in the morning and the evening. Multi-level modelling was applied to assess the relationships between variables. Analyses revealed that defeat predicted both same day and next day self-harm thoughts. Internal entrapment was associated with self-harm thoughts the same day, but did not predict

whether a young person would think about self-harm the next day. External entrapment was not related to short-term risk of self-harm thoughts in daily life. This pattern of results pertaining to defeat, internal entrapment and external entrapment also emerged when considering self-harm behaviour as an outcome. No symptoms of sleep disturbance predicted short-term risk of self-harm thoughts and behaviours. However, poor sleep quality was associated with increased perceptions of defeat the following day, whilst nightmare distress and intensity predicted greater levels of internal entrapment. No symptoms of sleep disturbance predicted next-day perceptions of external entrapment.

Taken together, these findings demonstrate the short-term predictive utility of perceptions of defeat and internal entrapment in terms of self-harm risk, but that symptoms of sleep disturbance were limited in predicting self-harm risk in the short-term. Furthermore, our results provide novel insights into the relationship between sleep problems, defeat and internal entrapment. The implications of these findings and key avenues for future research are discussed.

6.2.   Introduction

The systematic review and research agenda presented in Chapter 3 highlighted that in order to progress understanding regarding the link between sleep and self-harm risk in young people, there is a need for more prospective investigations, as well as research, which seeks to understand the psychological mechanisms underpinning this relationship. The research presented in Chapters 4 and 5 have advanced the field by addressing these limitations within the literature. Whilst this work is valuable in that it provides novel insights into the relationship between sleep and self-harm in young people, and provides direction for further exploration, it

provides limited information about the extent to which sleep and psychological factors predict short-term risk of these phenomena.

6.2.1. The need to predict short-term self-harm risk in young people

To date, our understanding of self-harm thoughts and behaviours during adolescence (and the role of sleep disturbance as a precursor) has been informed by cross-sectional investigations or prospective studies that span months or years. A recent meta-analysis demonstrated that this pattern is prevalent throughout the field of suicide and self-harm research (Franklin et al., 2017). When considering all studies that have examined predictors of suicide risk during the past 50 years, only 5% of had a follow up period of less than six-months, less than 1% had follow up lengths of one month or less, and the average study spanned a period of ten years. Similarly, of the thousands of studies that have investigated risk factors for self-harm thoughts and behaviour in young people, only a single investigation has examined prediction across a short time frame. This is problematic as overreliance on these designs limits our ability to predict who may be at imminent risk of self-harm and to determine the circumstances under which can risk develop. This knowledge is important if we are to effectively assess, monitor, predict, and prevent self-harm thoughts and behaviour in young people. As a result, there has been a call for more research that seeks to improve understanding of short-term prediction of suicide and self-harm in young people (Cha et al., 2018; Glenn & Nock, 2014; Kleiman et al., 2019).

Previous longitudinal studies (n=6) examining the relationship between sleep problems and self-harm risk in young people have had follow up intervals ranging from 6 months to 4 years and have applied measures that aggregate information

about key variables across a period of days, weeks or months. Whilst these investigations have demonstrated that further exploration of this link is warranted and provided a foundation for future research to build upon, they fail to account for the fluctuating nature of both sleep disturbance and self-harm during adolescence (Becker, Sidol, Van Dyk, Epstein, & Beebe, 2017; Czyz, King, Nahum-Shani, 2018). That is to say that previous research assumes that sleep and self-harm are static whilst in fact they may be dynamic and vary within and across days. The aggregation of responses is also concerning as those working to support young people are often required to make decisions about acute risk (i.e., across hours and days) rather than risk across weeks and months.

The same is also true when considering available evidence regarding the nature of theoretically salient indicators of self-harm risk in daily life. Despite the relevance of the IMV to understanding pathways to self-harm, research has not yet investigated the short-term predictive utility of the central components of this model. For example, although research provides consistent support for the role of defeat and entrapment in pathways to suicide and self-harm, this support comes from research employing cross-sectional research designs or prospective investigations with extended follow up periods (e.g., Littlewood et al., 2016b; Owen et al., 2018; Rasmussen et al., 2010). As such, the role of these psychological constructs in relation to short-term self-harm risk is not yet known, and it remains unclear whether perceptions of defeat and entrapment are proximal predictors or if they better explain self-harm risk over a longer period. Research of this nature is important for the refinement of theoretical conceptualisations of self-harm risk.

Taken together, it is clear that there is a pressing need for investigations that acquire short-term prospective data within the context of a young person's day-to-

day life. Research of this nature has greater ecological validity and has the potential to capture the true fluctuating nature of self-harm and its associated risk and protective factors. An innovative way of collecting this form of data and identifying short-term predictors of self-harm risk is to employ micro-longitudinal research designs such as experience sampling methodology (a.k.a. ecological momentary assessment). This research design involves repeated assessment of constructs of interest over a period of several days, within the participant's natural setting (Larson & Csikszentmihalyi, 1983; Myin-Germeys et al., 2009). Recent advances in technology and the pervasiveness of smartphones have made research of this nature more accessible, and have created an opportunity for new scientific, theoretical and clinical advances (Palmier-Claus, Haddock, & Varese, 2019). Consequently, there has been a marked increase in the popularity of micro-longitudinal assessment in recent years (Kleiman, Glenn & Liu, 2019).

6.2.2. Lessons learned from micro-longitudinal investigations

The majority of work employing micro-longitudinal techniques in the field of suicide and self-harm research has focused on adults (Husky et al., 2014; Husky et al., 2017; Kleiman et al., 2017; Kleiman & Nock, 2018; Littlewood et al., 2019). This research has demonstrated that it is feasible to assess suicidal thoughts and behaviours using real-time monitoring techniques, and has highlighted that suicidal ideation varies substantially over a short period of time (Husky et al., 2014; Kleiman et al., 2017). Moreover, investigations employing micro-longitudinal designs with adults have begun to provide valuable insights into the role of theoretically derived risk factors for suicide risk. Specifically, Kleiman et al. (2017) revealed that hopelessness, loneliness and burdensomeness (i.e., core constructs of the

Hopelessness and Interpersonal-Psychological theories of suicide) exhibit significant variability across a period as short as four to eight hours, and that these variables correlated with suicidal ideation in the moment (i.e., as it occurs). However, they were limited in predicting suicidal ideation over a short period.

In spite of the fact that adolescence is a high-risk period for suicide and self-harm, micro-longitudinal research that examines these thoughts and behaviours in young people is limited. A recent review (Kleiman et al., 2019) highlights that micro-longitudinal assessment is feasible in adolescent samples (Czyz et al., 2018; Wen, Schneider, Stone & Spruit-Metz, 2017), and that suicidal ideation and thoughts of non-suicidal self-injury exhibit considerable day-to-day variability (Czyz, Horwitz, Arango & King, 2019; Nock et al., 2009b). Taken together, these findings suggest that intensive longitudinal assessment is likely to be useful in the study of self-harming thoughts and behaviours in young people. Only one investigation has examined the degree to which theoretically informed risk factors were associated with suicidal ideation in daily life (Czyz et al., 2019). In line with the findings obtained from adults, findings from this research suggested that connectedness, burdensomeness and hopelessness predicted concurrent, but not short-term prospective suicidal ideation.

To date, no micro-longitudinal investigations have examined adolescents' self-harm thoughts and behaviour more broadly (i.e., irrespective of motivation and intent). As such, our understanding of these phenomena within the context of daily life is limited. Furthermore, there is a need to examine the degree to which other established risk factors facilitate the short-term prediction of self-harm thoughts and behaviours. Research of this nature will aid identification and treatment of young people who are at imminent risk of engaging in self-harm (Cha et al., 2018).

Consequently, using micro-longitudinal techniques to investigate the interrelations between sleep, self-harm risk and psychological factors represents a promising direction for future research.

6.2.3. Examining sleep, self-harm risk and psychological factors in the context of daily life.

Although a growing body of evidence supports a link between sleep disturbance and self-harm/suicide risk (Littlewood et al., 2017; Pigeon et al., 2012; Russell et al., 2019), only two studies have sought to establish whether sleep disturbance represents a promising candidate in the short term prediction of suicidal/self-harming thoughts and behaviour. Notably, both of these investigations have been conducted within adult populations. First, Hochard et al. (2015) provided empirical support for a unidirectional relationship between nightmares and self-harming thoughts and behaviours. Further exploration demonstrated that post-sleep negative affect partially mediated this association. Second, Littlewood et al. (2019) revealed that sleep quality and short sleep duration predicted next-day suicidal ideation in a sample of adults with current suicidal ideation. Moreover, sleep quality mediated the link between pre-sleep entrapment and suicidal ideation the following day. Based on our previous findings (presented in Chapters 4 and 5), and research evidence that supports the acceptability and feasibility of micro-longitudinal research in samples of adolescents, a logical and necessary next step is to examine the link between symptoms of sleep disturbance, self-harm risk and psychological factors (specifically defeat and entrapment) in the context of adolescents' daily life.

6.2.4. **The current study**

In order to address limitations within the extant literature and progress understanding regarding the short-term prediction of self-harm risk in young people, the current investigation aims to implement micro-longitudinal assessments to examine interrelationships between sleep, self-harm thoughts and behaviours, and psychological factors in young people. More specifically, the aims of the current investigation were:

1. To establish the extent to which sleep disturbance, psychological factors (i.e., defeat, internal entrapment, and external entrapment) and self-harm thoughts and behaviour exhibit day-to-day variability in young people.

2. To determine whether perceptions of defeat, internal entrapment, and external entrapment predict self-harm thoughts and behaviour concurrently and prospectively (i.e., the next day).

3. To examine whether symptoms of sleep disturbance are associated with perceptions of defeat, internal entrapment, and external entrapment the following day.

4. To establish whether specific sleep parameters and disturbances predict self-harm thoughts and behaviours the next day.

Four hypotheses were generated. First, it was expected that sleep disturbance and self-harm thoughts and behaviour would demonstrate day-to-day variability. As this is the first investigation of defeat and entrapment in daily life, no predictions were made. Second, it was predicted that increased perceptions of defeat and entrapment would predict self-harm thoughts and behaviours in the short-term (i.e. both on the same day and next day). Third, it was hypothesised that symptoms of sleep

disturbance would predict next day perceptions of defeat, internal entrapment and external entrapment. Fourth, it was predicted that disturbed sleep would be associated with self-harm thoughts and behaviours the subsequent day. When considering individual sleep parameters, no specific predictions were generated as this is the first study of this kind within an adolescent population, and young people demonstrate sleep patterns, and vulnerabilities to sleep problems that as specific to their own developmental period (Carskadon, 2011).

6.2. **Methods**

The current investigation included five stages: 1) recruitment 2) briefing, 3) baseline assessment, 4) a seven-day period of micro-longitudinal assessment and, 5) debriefing. A visual representation of the study protocol is provided in Figure 6.1.

Figure 6. 1. Visual representation of five-stage study protocol including 1) recruitment , 2) briefing, 3) baseline assessment, 4) a seven day period of micro-longitudinal assessment and, 5) debriefing.
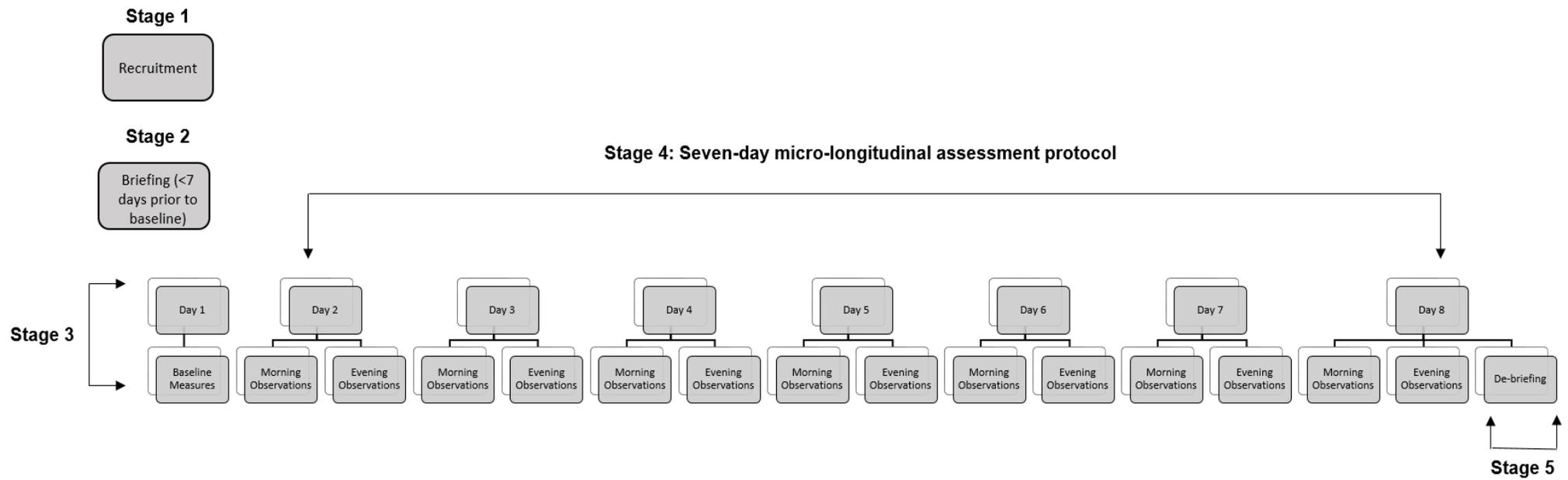
6.2.1. Participants

In total, 135 participants were recruited from four mainstream secondary schools in Scotland. Of the original sample, 73.4% (n=97) adhered to minimum compliance levels. This required participants to complete more than one third of entries (Palmier-Claus et al., 2011; Littlewood et al., 2017). Young people were aged 14 to 17 (M = 16.32, SD = 0.68) and the majority of participants (75.3%) were female.

6.2.2. Measures and procedure

6.2.2.1.   Recruitment and briefing

Ethical approval was obtained from the University Ethics Committee (UEC16\47 and this investigation was conducted in line with guidance from both the British Psychological Society and the British Educational Research Association. Once permission had been received from a hierarchy of gatekeepers (i.e., local education authorities, a member of each school's senior management team and parents/guardians), young people were invited to participate in this micro-longitudinal investigation. For those interested in taking part, informed consent was obtained and they were briefed on the study protocol no longer than one week prior to the first day of data collection (i.e., the baseline assessment). During the briefing procedure the lead researcher met with pupils in order to reinforce the nature and purpose of this investigation. At this point, young people were shown an example of the morning and evening surveys that they would be invited to complete for a period of seven days. This was to ensure that the pupils were familiar with (and understood) the questions before they were required to complete them on their own. Meeting with the young people also provided the opportunity for the lead researcher to address any questions or concerns that the participants had. Contact details were also provided in the event that the young

people wished to inquire about anything during the study protocol or in case any technical difficulties were experienced. During this initial briefing, data sampling windows were agreed with participants based on their habitual sleep and wake times. This is not common in micro-longitudinal investigations, but the decision to do so was taken to minimise protocol induced sleep disturbance and increase the likelihood of compliance.

6.2.2.2. Baseline assessment

Participants completed a battery of demographic and other self-report measures. These were completed the day prior to the micro-longitudinal phase of the investigation. The following variables were assessed:

- Age and sex

- Insomnia symptoms (Sleep Condition Indicator; Espie et al., 2014)

- Clinically salient nightmares (Disturbing Dreams and Nightmare Severity index; Krakow, 2006)

- Depressive symptomology (Hospital Anxiety and Depression Scale; Zigmond & Snaith, 1983)

- Defeat (Defeat Scale; Gilbert & Allen, 1998)

- Internal and external entrapment (Entrapment Scale; Gilbert & Allen, 1998)

We deemed it appropriate to investigate internal and external entrapment separately within the current study as we have found support for a two-factor structure of entrapment in two distinct samples of adolescents. The confirmatory factor analyses reported in Chapter 5 determined that entrapment was best conceptualised as a bidimensional construct. These findings were replicated when

examining the factor structure of the Entrapment Scale in the current investigation. These results are presented in Appendix K

These measures have been described in detail in Chapters 4 (subsection 4.2.2) and 5 (subsection 5.2.2).

6.2.2.4. Micro-longitudinal assessment period

Young people were invited to complete electronic diaries twice a day for a period of seven days. Assessments were completed in the morning upon awakening, and in the evening prior to going to bed. This protocol was chosen based on three practical considerations. First, many schools restrict phone use during the day (or ban pupils from bringing phones to school altogether) making it impossible to collect data throughout the school day. Second, previous research has demonstrated that the frequency of assessments can influence compliance rates, and that two to three assessment were deemed acceptable before response rates fell (Wen et al., 2017). It was expected that the phenomena of interest would be captured adequately via two diary assessments per day. Third, this protocol made it feasible for the lead researcher to monitor compliance and maintain risk assessments of the participating young people.

Participants received automatic SMS reminders from the lead researcher each morning and evening for a period of seven days. These messages contained a link to a brief electronic survey that was hosted on the Qualtrics survey platform (Qualtrics, Provo, UT). All participants completed the surveys on their smartphones, and survey links were sent according to the preferred schedule agreed during the briefing.

The decision to administer diaries online instead of on paper was taken for three reasons. First, given that participants were completing diaries across numerous days (including the weekend) it was determined that online surveys would be the best option in terms of research ethics. By completing responses online, data cannot be misplaced, and it is unlikely that friends and/or family members will see a participant's responses. Second, by storing responses online, the lead researcher was able to monitor compliance. Responses were dated and time-stamped automatically, and so it was possible to determine which participants had completed the diaries and when they had done so. If a participant failed to complete a diary for three days (i.e., 6 diary entries in total) the researcher was able to engage in risk management checks to ensure that the young person was not at risk and to establish whether they wish to continue to participate in the survey. Participants were made aware of this protocol prior to giving informed consent. Six young people met this threshold of non-compliance during the seven-day study protocol and were contacted by the researcher via text message. Two of the participants reported that they were participating in the residential portion of the Duke of Edinburgh programme and were unable to access their phones. These participants re-engaged with the study protocol on their return home. The other four participants had taken the decision to withdraw from the research. Third, placing the diary online reduced the burden placed on individual schools in terms of times and resources, thereby encouraging more schools to participate in the research.

On awakening, participants reported on various aspects of their sleep, as well as their experience of defeat, internal entrapment, external entrapment, depressed mood, and any engagement in self-harm thoughts and behaviours that morning. Given the links between sleep disturbance, depression and self-harm, depressed

mood was assessed at the day-level in order that it could be included as a covariate in all analyses. Subjective sleep parameters and insomnia symptoms were assessed using a modified version of the Consensus Sleep Diary (Carney et al., 2012). This sleep diary has been deemed the gold standard method for collecting data on subjective sleep parameters (Buysse et al., 2006). For the purposes of the current investigation, sleep diaries were used to assess five symptoms of sleep disturbance that characterise Insomnia Disorder. These were sleep onset latency, wake after sleep onset, sleep efficiency, total sleep time and subjective sleep quality, which young people were asked to rate on a scale ranging from 1 ("very poor") to 5 ("very good"). The Consensus Sleep Diary was modified to include questions about participants' experience of nightmares. Although the results of our school-based investigation (Chapter 4) suggest that nightmares do not predict future self-harm thoughts or behaviours across a six-month period, previous research with adults supports a unidirectional relationship between nightmares and self-harm risk the following day (Hochard et al. 2015). No published investigations have examined the short-term predictive utility of this symptom of sleep disturbance during adolescence; therefore it was deemed appropriate to modify the original sleep diary to include nightmares. Based on the core criteria of Nightmare Disorder (Krakow, 2006), participants were asked to indicate whether they had experienced a disturbing dream or nightmare the previous night (Yes/No), the extent to which it was associated with distress, how vivid it was, and the intensity of the disturbing dream or nightmare. Participants were asked to indicate the extent to which nightmares were distressing, vivid and intense using on a 5-point Likert scale ranging from 0 ("Not at all") to 4 ("Extremely").

In the evening, prior to going to bed, participants were asked to report on their experience of self-harm thoughts, self-harm behaviours, depressed mood, and perceptions of defeat, internal entrapment and external entrapment since completing the previous survey. The central component of any micro-longitudinal study is the items that are used to assess key constructs under investigation (Palmier-Claus et al., 2011). When using these techniques, it is important that the wording captures the response within the context of daily life, and that the time-frame of the assessment is clear (Palmier-Claus et al., 2019). Tables 6.1 and 6.2 summarises the items used to assess key variables within both the morning and evening surveys (with the exception of sleep disturbance).

Table 6. 1. Items used to assess variables within morning surveys

Variable	Item	Response
Self-harm thoughts	*Since waking up, I have thought about harming myself*	Yes/No
Self-harm behaviours	*Since waking up, I have intentionally harmed myself*	Yes/No
Defeat	*Currently, I feel defeated*	1 -7
Internal Entrapment	*Currently, I feel like I cannot escape my thoughts and feelings*	1-7
External Entrapment	*Currently, I feel trapped by my circumstances*	1-7
Depressed mood	*Currently, I feel depressed*	1-7

Note: Continuous scales ranged from 1 ("Not at All) to 7 ("Very Much So")

Table 6. 2. Items used to assess variables within evening surveys

Variable	Item	Response
Self-harm thoughts	*Since completing the last diary, I have thought about harming myself*	Yes/No
Self-harm behaviours	*Since completing the last diary, I have intentionally harmed myself*	Yes/No
Defeat	*Currently, I feel defeated*	1 -7
Internal Entrapment	*Currently, I feel like I cannot escape my thoughts and feelings*	1-7
External Entrapment	*Currently, I feel trapped by my circumstances*	1-7
Depressed mood	*Currently, I feel depressed*	1-7

Note: Continuous scales ranged from 1 ("Not at All) to 7 ("Very Much So")

6.2.2.5 Debriefing

Upon completion of the study, participants were fully debriefed regarding the nature and purpose of the study. They were provided with the details of a range of support organisations in the event that they had been affected by any of the issues raised during the study. Teachers and school staff were also made aware of the focus of the current research so that that they were prepared to support any young people that may wish to disclose self-harm thoughts and behaviour to them during, or following the investigation.

6.2.3. Data analytic strategy

All data analysis was conducted using R, within the R studio development environment (R Studio Team, 2018). As observations were nested within days, and days were nested within individual participants (Figure 6.2), our data has a multi-level structure and therefore violates the assumption of independence. Multi-level modelling techniques are able to provide accurate parameter estimates of nested data by deconstructing variance into between and within subject levels.

Given the nested nature of the data collected during micro-longitudinal investigations, estimates of both within-subject and between-subject variation are required to establish the size of sample needed to achieve the desired level of power. However, as that this is the first investigation to examine predictors of self-harm within the context of adolescent's daily life, these were not readily available. We settled on a target sample size of 300 participants after consulting previous micro-longitudinal studies that had focused on other aspects of adolescent mental health and accounting for the prevalence (18%) of self-harm in our previous investigation.
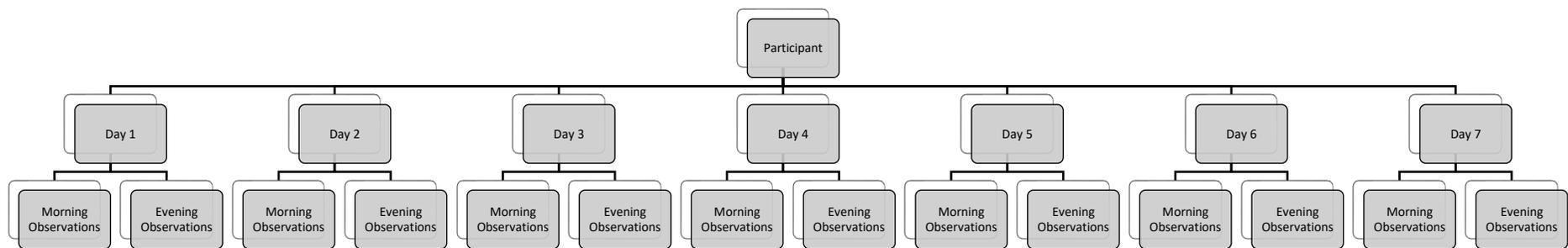
Figure 6. 2. Visual representation of multi-level data structure for the seven days of micro-longitudinal assessment

Symptoms of sleep disturbance were assessed only in the morning, whilst all other study variables were captured twice a day. As sleep was measured at the day level, the daily means of depressed mood, defeat, internal entrapment and external entrapment were calculated. Moreover, a participant was recorded as having thought about or engaged in self-harm that day if they endorsed doing so in either the morning or the evening survey.

To test the first hypothesis, that sleep parameters and self-harm thoughts and behaviours would demonstrate day-to-day variability, intra-class correlations were calculated. To examine the second hypothesis, namely that perceptions of defeat and entrapment would predict same-day and next-day self-harm thoughts and behaviour, twelve two-level logistic regression models were calculated. For the purposes of investigating the short-term predictive utility of defeat, two two-level random intercepts models were calculated with defeat as the predictor variable, and either same-day or next-day self-harm thoughts as the outcome variable. These models were replicated with internal and external entrapment entered individually as predictors. Given that these specific subtypes are highly correlated (i.e., $r = .732$, $n = 97$, $p = .001$), external entrapment was included as a covariate when evaluating internal entrapment as a predictor and vice versa.

To test the third hypothesis, that symptoms of sleep would be associated with perceptions of defeat, internal and external entrapment the following day, ten two-level random intercept models were calculated with individual sleep parameters entered as predictors, day level depressed mood as a covariate and defeat as the outcome variable. These models were then replicated, with the only difference being that the outcome variable was replaced with internal entrapment and then external entrapment respectively.

To test the fourth hypothesis, that symptoms of disturbed sleep would be associated with self-harm thoughts and behaviour the next day, ten two-level random intercept models were calculated with individual sleep parameters entered as predictors, and either self-harm thoughts or behaviour as the outcome variable. Given the relationships between sleep, depression, and self-harm risk, day-level depressed mood was included as a covariate within all analyses included in the current investigation. In all analyses, predictor variables were participant mean centred. This option was chosen as it is the most appropriate strategy when participant means are expected to differ meaningfully, or if variations from a participant's average or baseline are theoretically important to the model being tested (Kleiman, 2019). The results of the previous chapter demonstrated that there were significant differences between young people with and without disturbed sleep across all study variables, and intra-individual variation in sleep parameters impacts negatively on mental health outcomes (Becker et al., 2016).

6.3. Results

6.3.1. Preliminary analyses

Overall, 19.6% of the sample (n=19) reported experiencing clinically salient insomnia symptoms, 40.2% (n=39) reported a history of self-harm thoughts, and 34.1% (n=33) had engaged in self-harm at some point in their lifetime. During the seven days of micro-longitudinal assessment, self-harm thoughts were reported within 66 (of a total of 1318) surveys, and by 20 participants (20.6%). On average, these participants had thought about harming themselves on 3.25 of the seven assessment days. Moreover, 11 participants acted on these thoughts (11.3%), and endorsed engagement in self-harm behaviours within 20 of the surveys. On average,

these participants reported engaging in self-harm on 1.72 days of the seven-day data collection period.

In term of adherence, our study resulted in a 73.1% compliance rate. Overall, sleep diaries captured 84.5% of the 659 nights that were assessed (n=556). Participants contributed information about self-harm thoughts within 91.0% of surveys (n=559), and completed 89.8% of items assessing self-harm behaviours (n=592). Furthermore, adherence was also excellent concerning items assessing defeat (90.8%), internal entrapment (91.6%) and, external entrapment (91.6%). Table 6.3 presents descriptive and variability statistics for all study variables.

Table 6. 3. Descriptive and variability statistics for daily measures of sleep disturbance, defeat, entrapment and self-harm thoughts and behaviours.

Predictor variable	Unit of measurement	Grand Median	IQR	Range	ICC
Sleep Onset Latency	Minutes	15	20	0-180	0.25
Wake After Sleep Onset	Minutes	0	10	0-240	0.12
Sleep Efficiency	Percentage	83	17	28.15-100.00	0.30
Total Sleep Time	Minutes	450	75	135-760	0.15
Sleep Quality	1 ("Very Poor) to 5 (Very Good)	3	1	1-5	0.42

Nightmare Distress	1 ("Not at all") to 5 ("Extreme)	1	0	1-5	0.05
Nightmare Vividness	1 ("Not at all") to 5 ("Extreme)	1	0	1-5	0.05
Nightmare Intensity	1 ("Not at all") to 5 ("Extreme)	1	0	1-5	0.04
Defeat	1 ("Not at all") to 7 ("Very Much So)	1	1.5	1-7	0.54
Internal entrapment	1 ("Not at all") to 7 ("Very Much So)	1.5	2	1-7	0.64
External entrapment	1 ("Not at all") to 7 ("Very Much So)	1	1.5	1-7	0.61
Depressed mood	1 ("Not at all") to 7 ("Very Much So)	1	1.5	1-7	0.67

6.3.2. Do sleep parameters, defeat, entrapment and self-harm risk vary over short periods of time?

The intra-class correlations presented in Table 6.3 indicate that all variables exhibit considerable variation across the seven days of micro-longitudinal assessment. More specifically, 37% and 67% of variability in self-harm thoughts and self-harm behaviours were due to within person (1-ICC) variation. Defeat, internal entrapment, and external entrapment demonstrated that 44%, 36% and 39% of day-to-day fluctuation was accounted for by within person variability (vs. between person variation). Further, day-to-day variability ranged from 48% to 95% across symptoms of sleep disturbance.

6.3.3. Are perceptions of defeat and entrapment linked to same-day and next-day self-harm thoughts and behaviour?

Table 6.4 summarises the results of the three two-level random intercepts models calculated to examine the extent to which defeat, internal entrapment and external entrapment predict same-day self-harm thoughts (when adjusting for day-level depression). Defeat and internal entrapment predicted same-day self-harm thoughts. However, external entrapment did not. This suggests that feeling defeated and perceiving ones thoughts, and feelings to be inescapable, is concurrently associated with self-harm thoughts in daily life.

Table 6. 4. Association between defeat, entrapment and same-day self-harm thoughts

Predictor variable	OR	95% (CI)	SE	p
Defeat	2.11	1.13,3.94	0.03	<0.001
Internal entrapment	1.33	0.79, 2.26	0.26	0.021
External entrapment	1.28	0.79,1.86	0.21	.391

Three two-level random intercepts models were calculated to examine the extent to which defeat, internal entrapment and external entrapment predict next day self-harm thoughts (when adjusting for day-level depression). Table 6.5 provides an overview of the results. Defeat predicted next-day self-harm thoughts. However, internal and external entrapment did not. This indicates that increased perceptions of defeat may be a useful short-term predictor of whether young people may experience self-harm thoughts the following day.

Table 6. 5. Association between defeat, entrapment and next-day self-harm thoughts

Predictor variable	OR	95% (CI)	SE	p
Defeat	2.11	1.13,3.95	0.31	0.019
Internal entrapment	1.56	0.90-2.70	0.28	0.116
External entrapment	1.28	0.82, 2.00	0.20	0.275

Table 6.6 summarises the results of the three two-level random intercepts models applied examine the short-term predictive utility of defeat, internal entrapment and external entrapment in relation to same-day self-harm behaviours

(when adjusting for day-level depression). Defeat and internal entrapment predicted same-day self-harm behaviours, but external entrapment did not. This suggests that adolescents' perceptions of defeat and feeling trapped by their own thoughts and feelings relate to their risk of engaging in self-harm behaviours on the same day.

Table 6. 6. Association between defeat, entrapment and same-day self-harm behaviours

Predictor variable	OR	95% (CI)	SE	p
Defeat	1.97	1.06, 3.68	0.32	0.033
Internal entrapment	3.05	1.39, 6.71	0.42	0.005
External entrapment	1.14	0.64, 2.01	0.29	0.664

Table 6.7 summarises the results of the three two-level random intercepts models calculated to examine the extent to which defeat, internal entrapment and external entrapment predict next day self-harm behaviours (when adjusting for day-level depression). Defeat predicted next-day acts of self-harm. However, internal and external entrapment did not. This pattern of results imply that feeling more defeated may be a useful indicator of whether young people may engage in self-harm behaviours the following day.

Table 6. 7. Association between defeat, entrapment and next-day self-harm behaviours

Predictor variable	OR	95% (CI)	SE	p
Defeat	2.06	1.06,3.68	0.32	0.030
Internal entrapment	0.78	0.35,1.72	0.31	0.196
External entrapment	1.85	0.99, 3.44	0.32	0.112

6.3.4. Do sleep parameters predict perceptions of defeat and entrapment the following day?

Ten two-level random intercepts models were calculated with a view to examining whether symptoms of sleep disturbance predicted next-day perceptions of defeat. Table 6.8. summarises the results of this statistical analyses. Only poor sleep quality predicted increased feelings of defeat the following day.

Table 6. 8. Association between symptoms of sleep disturbance and next-day perceptions of defeat

Predictor variable	β	95% (CI)	SE	p
Sleep Onset Latency (min)	0.00	0.00,0.01	0.01	0.427
Wake After Sleep Onset (mins)	0.01	0.01,0.02	0.01	0.624
Sleep Efficiency (%)	0.00	0.00,0.01	0.01	0.933
Total Sleep Time (min)	0.00	0.00, 0.01	0.01	0.833
Sleep Quality (score 1-5)	-0.11	-0.18, -0.01	0.04	0.031
Nightmare (y/n)	0.06	-0.20,0.31	0.13	0.665
Nightmare Distress (score 1-5)	0.05	-0.03, 0.15	0.04	0.281
Nightmare Vividness (score 1-5)	0.03	-0.05, 0.13	0.04	0.549
Nightmare Intensity (score 1-5)	0.06	-0.03, 0.15	0.04	0.176

Table 6.9. provides an overview of the results obtained from ten two-level random intercepts models exploring the short-term predictive utility of symptoms of sleep disturbance in relation to perceptions of internal entrapment the following day. Increased nightmare distress and intensity predicted next-day internal entrapment. These findings suggest that young people experiencing distressing and/or intense nightmares are more likely to perceive their thoughts and feelings to be inescapable upon awakening.

Table 6. 9. Association between symptoms of sleep disturbance and next-day perceptions of internal entrapment

Predictor variable	β	95% (CI)	SE	p
Sleep Onset Latency (min)	0.01	0.00,0.01	0.01	0.221
Wake After Sleep Onset (mins)	0.01	0.00,0.01	0.01	0.081
Sleep Efficiency (%)	0.01	0.00,0.01	0.01	0.171
Total Sleep Time (min)	0.01	0.00,0.01	0.01	0.511
Sleep Quality (score 1-5)	-0.09	-0.28, -0.07	0.05	0.061
Nightmare (y/n)	0.23	-0.03, 0.32	0.14	0.081
Nightmare Distress (score 1-5)	0.15	0.05, 0.24	0.05	0.003
Nightmare Vividness (score 1-5)	0.04	-0.06, 0.14	0.05	0.416
Nightmare Intensity (score 1-5)	0.12	0.02, 0.22	0.05	0.014

Ten two-level random intercepts models were applied to examine whether perceptions of external entrapment upon awakening are predicted by symptoms of sleep disturbance. Table 6.10. summarises the results of this statistical analyses. No sleep parameters were associated with young people's feelings of being trapped by external circumstances the following day.

Table 6. 10. Association between symptoms of sleep disturbance and next-day perceptions of internal entrapment

Predictor variable	β	95% (CI)	SE	p
Sleep Onset Latency (min)	0.01	0.00,0.01	0.01	0.862
Wake After Sleep Onset (mins)	0.01	0.00,0.01	0.01	0.524
Sleep Efficiency (%)	0.01	0.00,0.01	0.01	0.861
Total Sleep Time (min)	0.01	0.00,0.01	0.01	0.925
Sleep Quality (score 1-5)	-0.10	-0.21, - 0.01	0.05	0.061
Nightmare (y/n)	-0.03	-0.35, 0.28	0.16	0.848
Nightmare Distress (score 1-5)	-0.01	-0.12-0.10	0.06	0.797
Nightmare Vividness (score 1-5)	-0.10	-0.21-0.01	0.06	0.072
Nightmare Intensity (score 1-5)	-0.06	-0.17, 0.05	0.06	0.307

6.3.5. Do sleep parameter predict next-day self-harm thoughts and behaviours?

Table 6.11. summarises the results of the ten two-level random intercepts models calculated to examine the extent to which symptoms of sleep disturbance predicted adolescent's risk of experiencing self-harm thoughts the following day. No sleep parameters predicted next-day self-harm thoughts.

Table 6. 11. Association between symptoms of sleep disturbance and next-day self-harm thoughts

Predictor variable	OR	95% (CI)	SE	p
Sleep Onset Latency (min)	1.01	0.99,1.03	0.01	.485
Wake After Sleep Onset (min)	1.01	0.99,1.03	0.01	0.914
Sleep Efficiency (%)	0.97	0.93,1.02	0.02	0.476
Total Sleep Time (min)	1.01	0.99,1.01	0.01	0.566
Sleep Quality (score 1-5)	0.49	0.22,1.10	0.41	0.059
Nightmare (y/n)	0.80	0.15,4.39	0.86	0.798
Nightmare Distress (score 1-5)	1.04	0.60,1.82	0.27	0.951
Nightmare Vividness (score 1-5)	1.00	0.54,1.82	0.31	0.998
Nightmare Intensity (score 1-5)	1.15	0.66,2.01	0.28	0.675
Sleepy				

Table 6.12. provides an overview of the results of the ten two-level random intercepts models applied to determine the whether adolescents risk of engaging in self-harm was predicted by symptoms of sleep disturbance the previous night. No sleep parameters predicted whether young people would intentionally harm themselves the next day.

Table 6. 12. Association between symptoms of sleep disturbance and next-day self-harm behaviours

Predictor variable	OR	95% (CI)	SE	p
Sleep Onset Latency (min)	1.01	0.99,1.03	0.01	0.401
Wake After Sleep Onset (mins)	0.99	0.97,1.01	0.01	0.654
Sleep Efficiency (%)	1.03	0.96,1.01	0.03	0.381
Total Sleep Time (min)	1.00	0.99,1.01	0.44	0.654
Sleep Quality (score 1-5)	1.90	0.73,4.92	0.48	0.187
Nightmare (y/n)	0.62	0.08,4.66	1.02	0.644
Nightmare Distress (score 1-5)	0.86	0.43,1.70	0.35	0.658
Nightmare Vividness (score 1-5)	0.71	0.26,1.93	0.51	0.506
Nightmare Intensity (score 1-5)	0.60	0.20,1.92	0.53	0.408

Taken together, these findings suggest that symptoms of sleep disturbance are not useful short-term predictors of self-harm risk during adolescence.

6.4. Discussion

The current investigation intended to build on our work examining the role of sleep disturbance in the prediction of self-harm risk during adolescence. It is the first to employ micro-longitudinal assessment to examine interrelationships between sleep, self-harm thoughts and behaviours, and theoretically salient psychological factors in young people. The aims of this study were fourfold. First, we sought to

establish the extent to which sleep disturbance, psychological factors (i.e., defeat and entrapment) and self-harm thoughts and behaviours exhibited day-to-day variability in young people. Second, we wished to determine whether perceptions of defeat and entrapment predicted self-harm thoughts and behaviours in the short term. Third, we sought to examine whether symptoms of sleep disturbance are associated with perceptions of defeat, internal entrapment, and external entrapment the following day. Fourth, we wished to establish whether specific sleep parameters and disturbances predicted next-day self-harm thoughts and behaviours.

6.6.1. The dynamic nature of sleep disturbances, self-harm risk, and theoretically informed risk factors during adolescence

The majority of research has assessed sleep disturbances, defeat, entrapment, and self-harm thoughts and behaviour using measures that aggregate responses across a period of weeks or months (e.g., Blank et al., 2015; Hysing et al., 2014; Littlewood et al., 2016; Liu et al., 2016; Owen et al., 2017; Rasmussen et al., 2010; Siddaway et al., 2015; Wong et al., 2011). As such, the true nature of these constructs in adolescents' daily life, and the extent to which they exhibit variation over a short period of time and within a natural setting was unclear. Our findings reveal that sleep parameters and problems, self-harm thoughts and behaviours, and two theoretically informed risk factors (i.e., defeat and entrapment) vary considerably seven across seven days. These findings are in line with previous micro-longitudinal investigations in adults and adolescents which have highlighted that sleep disturbance and suicidal ideation exhibits substantial variation over a short period of time (Becker et al., 2017; Czyz et al., 2019; Kleiman et al., 2017). These results support our first hypothesis and demonstrate that previous findings extend to self-harm thoughts and behaviours more broadly.

No previous research has evaluated perceptions of defeat and entrapment using repeated assessment across a period of several days. Indeed, this is the first intensive longitudinal examination of central constructs from the IMV that has been conducted within the context of daily life. Consequently, our findings provide novel insights into short-term within-person variability of these theoretically salient psychological constructs, suggesting that they are dynamic state, or state like, perceptions. This variability suggests that these perceptions are well suited to intensive longitudinal assessment as these designs are only appropriate if the factors being monitored fluctuate over a short period of time. Kleiman et al. (2017) noted that well-known risk factors for suicidal ideation (hopelessness, burdensomeness and loneliness) fluctuated dramatically over the course of a day in adults. Therefore, a useful direction for future research would be to measure these perceptions more frequently throughout each day. Investigations of this nature will provide a more fine-grained understanding of whether defeat and entrapment vary over a period of several hours. Further, to understand the conceptualisation of defeat and entrapment in young people, it would be advantageous to consider which factors are associated with an increase in perceptions of defeat and entrapment. Micro-longitudinal investigations allow researchers to gather information about the context in which assessments are being undertaken. As such, it will be possible to determine which environmental and relational factors are associated with an increase or decrease in perceptions of defeat and entrapment within daily life.

6.6.2. Defeat and entrapment as short-term predictors of self-harm thoughts and behaviours

There is considerable support for the role of defeat and entrapment within pathways to suicide and self-harm (Cramer et al., 2019; Owen et al., 2017;

Rasmussen et al., 2010; Siddaway et al., 2015). However, no previous investigations had investigated the extent to which defeat and entrapment predict self-harm thoughts and behaviours in the short-term. Our results demonstrate that defeat predicted concurrent and next day self-harm thoughts and behaviour, whilst internal entrapment predicted self-harm thoughts and behaviour the same day, but not the following day. Perceptions of external entrapment were not associated with self-harm risk within the context of daily life. Our findings extend previous work (Siddaway et al., 2015; O'Connor & Portzky, 2018) by demonstrating that increased feelings of defeat and internal entrapment have short-term predictive utility. That is to say that, young people who are experiencing perceptions of defeat or who perceive their thoughts and feelings to be inescapable, may be at imminent risk of thinking about or engaging in self-harm. Therefore, these findings partially support our second hypothesis. Our results also have implications for self-harm theory. Defeat and entrapment are presented as proximal predictors of self-harm risk within the IMV. However, this hypothesis has never been tested. Given that, defeat and internal are predict both self-harm thoughts and behaviour the same day, our findings provide empirical support for this prediction.

Our finding that internal entrapment (but not external entrapment) predicts self-harm thoughts and behaviours reinforces findings from Chapter 5, and the wider body of research (Cramer et al., 2019; Rasmussen et al., 2010; DeBeurs et al., 2019), which highlight that the relationships between internal entrapment and self-harm risk are more robust than the perception that external circumstances are inescapable. This pattern of findings suggests that an individual is more likely to harm themselves when they feel unable to escape from themselves (i.e., from their own thoughts, memories and feelings) compared to feeling trapped by external

circumstances or people. These results provide a more nuanced understanding of the role of defeat and entrapment in relation to self-harm thoughts and behaviours, and provide direction for possible refinement of the IMV. Our work also contributes to the growing body of evidence that highlights the role of entrapment within acute suicidal crisis syndrome (Li et al., 2018). Finally, these results reinforce the assertion that micro-longitudinal methodologies facilitate the testing of psychological theories in adolescent samples and have the potential to advance our understanding of risk processes in daily life (Rodríguez-Blanco et al., 2018).

6.6.3. The link between symptoms of sleep disturbance and perceptions of defeat and entrapment.

In chapter 5, we investigated the relationship between clinically salient symptoms of insomnia and perceptions of defeat and entrapment. Young people reporting insomnia symptoms reported elevated perceptions of defeat and entrapment relative to those who did not meet the clinical threshold for insomnia disorder. Further, perceptions of defeat and internal entrapment mediated the link between insomnia symptoms and self-harm thoughts. The current investigation sought to extend these findings by examining the short-term associations between a wider range of specific sleep parameters and perceptions of defeat and entrapment. It was intended that this would provide a more fine-grained understanding of this relationship. Two particularly notable findings emerged. First, poor sleep quality predicted subsequent perceptions of defeat. Second, nightmare distress and intensity were associated with increased perceptions of defeat and entrapment the following day. These findings partially support our hypothesis.

Sleep quality refers to an individual's overall subjective appraisal of whether the quality of their sleep is good or poor, and research in adult samples suggests

that these appraisals can be driven by experiences through the night, upon awakening and throughout the following day (Harvey et al., 2008). As such, it is possible that a young person feels defeated as a result of experiencing a night of sleep that they perceive to be of poor quality, and the impact this has on their ability to function effectively the following day (e.g., socially or academically). A night of poor quality sleep may also be perceived as defeating if the young person believes that they are unable to control or predict the quality of their sleep in the future (Morin et al., 2007). That is, subjectively poor sleep quality may lead a young person to worry about their ability to obtain a good quality sleep the following evening, and result in the adolescent catastrophizing about the negative consequences of not getting a good quality sleep. These findings underscore the need for research that seeks to better understand the how young people generate perceptions of their own sleep quality (i.e., what factors are considered when determining if sleep was good or poor quality).

Previous research has demonstrated cross-sectional relationships between nightmares and entrapment (Littlewood et al., 2016; Littlewood et al., 2019). Our work extends these findings by examining the occurrence of nightmares and their associated specific dimensions (distress, vividness, and intensity) in relation to distinct subtypes of entrapment (i.e., internal and external). Our findings reveal that young people who report experiencing greater feelings of distress in response to their nightmares, and/or nightmares that were of increased intensity, were more likely to endorse feeling trapped by their thoughts and feelings the following day. Nightmare distress is characterised as the general level of distress in waking life caused by experiencing nightmares (Blagrove, Farmer & Williams, 2004), and can result in fear of going to sleep (Belicki, 1992). As a result, it could be that nightmare

distress contributes to internal entrapment by encouraging young people to avoid sleep, thereby preventing them from obtaining a nocturnal escape from negative thoughts and feelings (Littlewood et al., 2017). For example, in the first qualitative examination of the link between sleep disturbance and suicide risk, Littlewood et al., (2017) noted one participant's emphasis on their conflict between a desire to escape from negative waking thoughts, and a reluctance to go to sleep that is triggered by a fear of experiencing distressing nightmares.

In respect of the link between nightmares intensity and internal entrapment, it is possible that young people are experiencing post-traumatic nightmares. These nightmares are direct replications of a traumatic event, contain trauma related emotion, or content that is symbolically related to the trauma (Gieselmann et al., 2018). Post-traumatic nightmares are characterised by marked intense negative emotions, and awakenings are often accompanied by an intense or prolonged sense of fear and anxiety. Furthermore, intense nightmares are a key indicator of hyperarousal – a condition characterised by high levels of cognitive, physiological and emotional arousal (Bonnet & Arand, 2010). As such, young people may find their thoughts and feelings to be inescapable due to experiencing the symptoms of hyperarousal associated with intense nightmares. It is important to mention, however, that these are merely *hypothesised* mechanisms as we did not assess young people's experience of trauma, or PTSD and, therefore cannot confirm that the nightmares experienced during the seven-day period were post-traumatic in nature. Future research should aim to examine the links between trauma, nightmares, internal entrapment, and self-harm risk in young people. Further, it would be worthwhile to conduct qualitative work with young people who experience

nightmares to obtain a better grasp of how nightmare distress and intensity may contribute to increased perceptions of internal entrapment the following day.

6.6.4. Examining symptoms of sleep disturbance as predictors of next day self-harm thoughts and behaviours

Chapter 4 demonstrated that insomnia symptoms predicted future self-harm thoughts and behaviours. In addition, poor sleep quality was associated with an increased risk of engaging in subsequent self-harm behaviours. The current investigation aimed to provide a more nuanced understanding of this relationship by examining whether symptoms of sleep disturbance predict next day self-harm thoughts and behaviour. For example, whilst short sleep duration, longer sleep onset latency, poor sleep efficiency, and experience of nightmares did not predict self-harm thoughts or behaviours over a period of six-months, these sleep parameters on a given night may provide more predictive utility in relation to short-term self-harm risk. Sleep exhibits regular dynamicity in adolescents (Becker et al., 2017) and therefore is well suited to micro-longitudinal assessment.

Contrary to our hypotheses, no symptoms of sleep disturbance predicted self-harm thoughts and behaviours in daily life. These findings contradict previous findings established within adult populations (Hochard et al., 2015; Littlewood et al., 2019). Hochard and colleagues (2015) noted a unidirectional relationship between nightmares and self-harm thoughts and behaviours in a sample of university students. No aspects of nightmare experience (occurrence, intensity, vividness or distress) predicted next-day self-harm thoughts or behaviours in our sample of young people. These characteristics of nightmares may not offer short-term predictive utility in relation to self-harm risk during adolescence, and may instead better represent a background vulnerability factor (i.e., within the pre-motivational phase of the IMV).

Previous research in a sample of undergraduate students demonstrated that the length of time an individual has been experiencing nightmares for is a better predictor of suicide risk than current nightmares (Nadorff et al., 2013). It is possible that same is true for adolescents, and that there is a cumulative increase in risk over time.

Littlewood et al. (2019) revealed that poor sleep quality and short sleep duration predict next-day suicidal ideation in a sample of adults who had experienced Major Depressive Disorder (MDD). These sleep parameters were not associated with increased self-harm risk in the current study. Inconsistency in results may be accounted for by differences in sample characteristics and methodological considerations. First, Littlewood et al. (2019) employed a high-risk sample of adults with a history of mental health problems and current suicidal ideation, whilst the current investigation examined the link in a community-based sample of adolescents. It may be that links between symptoms of sleep disturbance and self-harm risk would have been revealed in more high-risk group of young people. Future research should aim to determine whether this is the case.

Second, important differences in measurement could explain why our findings differ from previous research. Within the current investigation we examined the *occurrence* of self-harm thoughts and behaviour, whilst Littlewood et al. (2019) examined the extent to which participants felt suicidal (ranging from "not at all" to "very much so"), and therefore taps into the *intensity* of suicidal ideation. It is possible that relationships vary according to different dimensions of this experience. Of course, it is important to mention that our research also examined self-harm thoughts more broadly (relative to thoughts specifically associated with suicidal intent), and findings may vary according to the conceptualisation of self-harm that is

implemented. Finally, differences in results could also be explained by the fact that we controlled for depressed mood at a day-level, whilst Littlewood et al. (2019) included baseline depressive symptoms as a covariate. Given that previous work in adolescents has demonstrated that sleep disturbance predicts depressive symptomology the following day, and that experience of depressive symptoms are noted to fluctuate over time, we chose to adjust for participants ratings of depression at a day-level. Future research should aim to determine whether symptoms of sleep disturbance are important in the short-term prediction of other dimensions of self-harm thoughts such as intensity, frequency or duration, rather than their occurrence alone. Whilst we examined a broad range of sleep parameters and problems, we did not assess the daytime impact that these symptoms of sleep disturbance had in adolescent's daily life. Future research should include items that assess this in order to determine whether the consequences of poor sleep for daily functioning are a better predictor of self-harm risk than nocturnal symptoms.

Finally, although we did not identify symptoms of sleep disturbance as a short-term predictor of self-harm thoughts and behaviours, our findings do reinforce that sleep problems and self-harm represent a significant problem for young people in Scotland. There was evidence of issues in sleep continuity (taking longer than 30 minutes to fall asleep or being awake for longer than 30 minutes during the night), duration, and quality in this sample. Further, a significant proportion met the clinical threshold for probable Insomnia Disorder and/or had recently experienced clinically salient nightmares. In addition, at least four in ten of the young people endorsed having ever thought about self-harm, and one in three had engaged in self-harm prior to taking part in the current investigation. Notably, rates are higher than our previous investigation where one in four reported a history of self-harm thoughts, and

one in six had harmed themselves intentionally. These findings suggest that, despite the original aim of obtaining a representative sample of young people, teachers may have put forward more "at-risk" pupils to take part. Alternatively, young people experiencing sleep problems or engaging in self-harm thoughts and behaviours may have been more motivated to participate in the research.

6.6.5. Strengths and limitations

The current investigation has two key strengths. First, the micro-longitudinal design offers a number of advantages over previous research that has set out to examine the link between sleep and self-harm risk in young people. More specifically, this design is characterised by repeated assessments that are completed within the context of everyday life. This reduces the influence of recall biases and increases ecological validity. Second, although lower than the average reported compliance rates in a recent meta-analysis of 42 studies employing micro-longitudinal research designs in clinical and non-clinical samples of adolescents (Wen et al, 2017), compliance rates were high (especially given that no incentives were offered to participating young people). This suggests that the use of these techniques to assess self-harm and its precursors is both acceptable and feasible in adolescent community samples. Efforts were made to increase compliance by implementing customised sampling schedules that were agreed with adolescents individually. This was particularly important given the inconsistency seen in young people's sleep schedules on school days and weekends, and the wish to minimise possible protocol related disruption to the their sleep. Future research should aim to evaluate what other factors are associated with increased compliance in this population.

This study also had three limitations that warrant further consideration. Firstly, our sample was predominantly made up of Caucasian females. Although young girls are significantly more likely to report sleep problems (Hysing et al., 2013), self-harm thoughts, and self-harm behaviours (Stallard et al., 2013), young males also experiences these phenomena. Therefore, the generalisations that can be made from our results are limited. An important future direction for research in this field, therefore, will be to employ micro-longitudinal assessments in larger and more diverse samples to determine which findings are replicable.

Second, although the decision to collect data using two assessments per day was well suited to the primary focus of this study (i.e., investigating the relationship between sleep, self-harm risk and psychological factors), it was not possible to examine relationships between some variables in more fine-grained detail. For example, the extent to which perceptions of defeat and entrapment vary throughout a day is not yet clear, nor are we able to determine whether these negative self-appraisals predict self-harm thoughts and behaviour across a period of hours. Assessing key variables more frequently across each day offers an even greater advantage in terms of reducing recall biases, and provides the opportunity to capture greater nuance in daily experiences of theoretically informed risk factors and self-harm thoughts and behaviours. However, the feasibility of a more burdensome sampling schedule will need to be established.

Third, whilst it is commonplace to assess psychological constructs of interest using single item measures, single item measures of suicidal and self-harming experiences have been highlighted as problematic (Milner et al., 2015). Similarly, it is not yet clear whether single item measures capture the true conceptualisation of defeat, internal entrapment, and external entrapment and (as this was the first study

to investigate these perceptions using single items) their psychometric properties were not available. However, this limitation is not unique to this study, and is inherent in any research that requires brief assessment to intensively measure the same constructs over a period of several days. We determined that the single item measures did demonstrate moderate correlations with the established multi-item measures that were employed during baseline assessment. However, further investigation is necessary to psychometrically validate these items.

6.6.6. Implications

The results of this investigation have implications for future research, theoretical conceptualisations of self-harm and clinical practice. Currently, there is limited information about the extent to which empirically supported risk factors are associated with acute risk of self-harm. As a result, there is currently a gap in our ability to determine which young people are at imminent risk of self-harmful thoughts and behaviours (Cha et al., 2018). The current investigation provides evidence for the acceptability and feasibility of employing micro-longitudinal assessments to assess precursors of self-harm risk in community-dwelling adolescents. These innovative research designs provide unprecedented opportunities to further test psychological theories of self-harm as well as examine the short-term predictive utility of a range of risk factors.

We demonstrated that perceptions of defeat, internal and external entrapment vary considerably over a period of seven days, thereby illuminating the dynamic and fluctuating nature of these psychological constructs. This finding highlights the valuable insights that micro-longitudinal research designs can provide, and suggests that future research should incorporate repeated measurement within the context of

daily life in order to get a true representation of the relationships between psychological factors and self-harm risk. For example, it remains to be seen if defeat and internal entrapment are associated with self-harm across a period of hours, rather than days. This information is key if we are to support young people who may be at imminent risk of harming themselves.

The findings presented within this chapter detail the most fine-grained understanding of the role of defeat and entrapment in the short-term prediction of self-harm thoughts and behaviour during adolescence to date. Despite the relevance of the IMV to understanding pathways to self-harm, research has not yet investigated the short-term predictive utility of the central components of this model. Consequently, our findings have implications for theoretical conceptualisations of self-harm during adolescence. Increased feelings of defeat and internal entrapment predicted same-day self-harm thoughts and behaviours. This finding supports the role of these psychological constructs as proximal risk factor within the IMV (O'Connor & Kirtley, 2018). When considered alongside the findings presented in Chapter 5 – that defeat and internal entrapment predicted self-harm risk across a six-month period – our findings indicate that these perceptions may have both static and dynamic conceptualisations (i.e., a state and a trait).

The results of our micro-longitudinal investigation reinforce the central role of internal entrapment (vs. external entrapment) within self-harm pathways. This suggests that a young person's perception that their thoughts and feelings are inescapable is a useful indicator of whether they are at risk of self-harm, and should guide any future refinement of contemporary psychological theories such as the IMV. Future research should aim to obtain a more fine-grained understanding of this relationship. For example, information on the nature of the thoughts and feelings that

young people want to escape, and the psychological pathways that give rise to the perception that they are inescapable would provide important insights that may can strengthen self-harm theory.

Specific symptoms of sleep disturbance did not predict self-harm thoughts and behaviours the following day. These findings are important when considering theoretical conceptualisations of the relationships between sleep disturbance and self-harm risk. That is, our results suggest that disturbed sleep (specifically insomnia symptoms) are better conceptualised as background vulnerability for self-harm risk during adolescence. More specifically, it appears that insomnia symptoms would be best placed within the motivational phase of the IMV.

Clinically, these findings suggest that defeat and internal entrapment may be meaningful targets for identifying and supporting young people who are at acute risk of engaging in self-harm thoughts and behaviours. Further, it is possible that ecological momentary interventions (those that incorporate mobile technology and are delivered to individuals in a natural setting within their daily lives) would be useful within this context (Myin-Germeys et al., 2016).

Our results also demonstrated that specific symptoms of sleep disturbance were associated with increased perceptions of defeat and entrapment the following day. Therefore, sleep interventions could be an important component of treatment plans, which have the aim of reducing these perceptions. More specifically, restoring healthy perceptions of sleep quality and tackling the distress associated with intense nightmares may be effective in reducing the extent to which adolescents feel defeated or trapped by their own thoughts and feelings. Interventions of this nature may indirectly reduce self-harm risk in young people. Taken together, our findings

build on our previous work and extend the existing literature. Several promising directions for future research have been suggested and results have the potential to inform specific empirically driven interventions to reduce risk of self-harm thoughts and behaviours in young people.

Key points from Chapter 6:

1. Sleep disturbance, perceptions of defeat and entrapment, and self-harm risk demonstrate considerable variation from day-to-day.

2. Increased perceptions of defeat and internal entrapment predict same-day self-harm thoughts and behaviour. External entrapment did not.

3. Subjective perceptions of poor sleep quality are associated with increased perceptions of defeat the following day, whilst nightmare intensity and distress leads young people to believe that their thoughts and feelings are inescapable. No symptoms of sleep disturbance were associated with external entrapment.

4. No symptoms of sleep disturbance predicted next day self-harm thoughts and behaviour. Given a lack of short-term predictive utility, our findings suggest the sleep problems may better represent a background vulnerability factor for self-harm risk.

Next steps:

The following chapter presents a general discussion of the empirical findings presented within this thesis. Strengths and limitations, potential directions for future research and possible implications of our results in terms of theory, practice, and policy will be discussed.

Chapter 7: General Discussion

Adolescence represents a high-risk period for the onset and persistence of self-harm. A crucial step in preventing self-harm in young people is identifying factors that are associated with increased risk, and clarifying the psychological mechanisms driving these relationships. This thesis had two overarching aims. First, to provide a more detailed and nuanced understanding of the association between specific symptoms of adolescent sleep disturbance and future self-harm thoughts and behaviours. Second, to establish which theoretically salient psychological processes underpin the relationships between disturbed sleep and self-harm risk in order to understand why the link exists. These aims were addressed by conducting a programme of research that comprised a systematic review, a six-month prospective study, and a micro-longitudinal investigation. Findings presented within this thesis provide novel insights into the relationship between specific aspects of sleep disturbance and subsequent self-harm risk (irrespective of motivation or intent) within the unique context of adolescent development. This chapter initially outlines our key findings. Following this, implications of these findings for theory, measurement, policy, and practice are discussed, before moving to consider the overarching methodological strengths and limitations of the work presented herein. Directions for future research and a concluding statement summarising the original contributions of this thesis will be provided.

7.1. Summary of findings

Chapters 1 and 2 highlighted that sleep problems and self-harm are global public health concerns, which emerge during adolescence, and outlined a rationale for examining sleep disturbance as a potential predictor of future self-harm risk.

Further, the need to examine theory-driven mechanistic pathways was highlighted as a necessary step in obtaining an understanding of why disturbed sleep infers increased risk for self-harm thoughts and behaviours. Figure 7.1. summarises the key findings obtained from the empirical investigations presented within this thesis.

Figure 7. 1. Summary of key findings reported in thesis

Thesis aims?

- 1. Provide a refined understanding of the link between specific symptoms of sleep disturbance and self-harm risk during adolescence.
- 2. Examine whether theoretically salient psychological factors drive the link between disturbed sleep and self-harm risk.

What?

- Clinically salient insomnia symptoms were associated with subsequent self-harm thoughts across a six-month period.
- Both insomnia symptoms and insomnia. symptoms predicted that young people would engage in first time or repeat self-harm.

Why?

- The link between insomnia symptoms and subsequent thoughts of self-harm is mediated by defeat and internal entrapment (but not external entrapment).
- These pathways remain significant when adjusting for depressive symptoms and history of self-harm thoughts and behaviours.

When?

- Insomnia symptoms and poor sleep quality predicted self-harm risk across a six month period. However no specific symptoms of insomnia or nightmares predicted self-harm thoughts or behaviours the following day.
- Insomnia symptoms do not predict self harm risk in the short-term and are better conceptualised as a distal vulnerability factor.

Chapter 3 evaluated the extant literature examining the link between sleep disturbance and self-harm risk (with and without suicidal intent) during adolescence. Taken together, the evidence base suggests that young people who experience subjective sleep problems are more likely to report suicidal and self-harming thoughts and behaviours. However, several methodological issues and challenges have limited the validity and generalisability of findings, and have prevented a more nuanced understanding of this relationship. Based on the limitations that were identified within the available evidence base, priorities for future work were established and presented in the form of a detailed research agenda. These recommendations were used to guide the design of the subsequent empirical investigations presented in this thesis.

Chapter 4 sought to quantify links between a range of symptoms of sleep disturbance and future self-harm thoughts and behaviours (whilst controlling for a range of covariates). Findings indicated statistically and practically significant relationships between specific aspects of sleep disturbance and self-harm thoughts and behaviours. Young people experiencing clinically salient insomnia symptoms are more likely to report having thought about harming themselves since completing the baseline measures. Further, both insomnia symptoms and perceptions of poor sleep quality during adolescence are associated with greater risk of the onset or repetition of self-harm behaviour during the follow up period. Sleep continuity, sleep duration, sleep timing, and nightmares were not prospectively associated with self-harm thoughts or acts.

By implementing an approach that accounted for the multi-dimensional nature of adolescent sleep disturbance, this investigation enhanced the existing literature in several ways. First, by providing evidence regarding specific aspects of sleep

disturbance that predict self-harm risk (i.e., insomnia symptoms and poor sleep quality). Second, by demonstrating that these relationships persist when adjusting for other robust and non-modifiable predictors of self-harm (such as history of these thoughts and behaviours). Third, by indicating that prospective relationships are not uniform across all aspects of sleep and, therefore, reinforcing the value of assessing multiple aspects of sleep disturbance simultaneously when conducting research during adolescence. Fourth, by providing up-to-date robust evidence that both sleep problems and self-harm represent public health concerns for adolescents living in Scotland. Overall, these results provide a more refined understanding of the relationship between sleep and self-harm thoughts and behaviours. However, to move the research forward, there was still a need to better understand why this link exists during adolescence.

The previous chapter laid the foundation for further work to expand upon. Chapter 5 built on the insights gained from findings presented in Chapter 4 by exploring which psychological mechanistic pathways drive the relationship between insomnia symptoms and subsequent self-harm risk. An isolated focus on self-harm thoughts as an indicator of self-harm risk was justified at this stage. Thinking about harming oneself is a proximal predictor of self-harmful behaviour (O'Connor, 2011; O'Connor & Kirtley, 2018). Therefore, identifying the pathways leading to self-harm thoughts (and increasing the potential to intervene at the start of this trajectory) is imperative to self-harm prevention (Jobes & Joiner et al., 2019).

Based on further analyses of data collected during our school-based prospective investigation, a hypothesised multi-step pathway (derived from the IMV) was supported whereby insomnia symptoms are associated with the development of subsequent self-harm risk via increased perceptions of defeat and internal

entrapment (but not external entrapment). These findings suggest that insomnia symptoms are associated with perceptions of defeat, and defeat is linked to the perception that thoughts and feelings are inescapable. Feeling internally trapped is related to the emergence of self-harm thoughts. Our work extends previous findings (Littlewood et al., 2016b) by testing the proposed psychological mechanistic pathway prospectively in young people, and considering the role of specific dimensions of entrapment within this context for the first time in the context of the sleep-self-harm link. Taken together, the findings presented in Chapters 4 and 5 provide novel and important insights into the complex associations between insomnia symptoms, defeat, entrapment and self-harm risk in young people.

The findings presented in Chapters 4 and 5 demonstrate that specific symptoms of sleep disturbance predict self-harm risk over a period of months. This was also true for perceptions of defeat and internal entrapment. Identifying young people who are at an acute risk of harming themselves is one key component of preventing self-harm and suicide during adolescence. As such the next logical and necessary step – to move this research forward- was to examine the short-term predictive utility of these factors in an adolescent's daily life. By employing a micro-longitudinal research design, it was possible to assess temporal relationships across a shorter (day-to-day) timeframe in order to determine whether sleep problems, defeat and entrapment could help identify which young people are at imminent risk of harming themselves.

Our results reinforced the importance of defeat and internal entrapment within self-harming pathways during adolescence. Namely, increased perceptions of these psychological constructs were associated with an increased likelihood that a young person would think about or engage in self-harm on that given day. Our analyses

identified that specific aspects of sleep disturbance predicted increased perceptions of defeat (i.e., poor sleep quality), and the perception that one's thoughts and feelings are inescapable (i.e., nightmare distress and nightmare intensity). All associations persisted when analyses adjusted for day-level depressed mood. However, no symptoms of disturbed sleep predicted engagement in self-harm thoughts or behaviour the following day. These findings are in contrast to those reported in adults (Hochard et al., 2015; Littlewood et al., 2019), which reinforces the importance of not drawing conclusions about adolescent populations from studies conducted in adult samples. However, as this is the first investigation to examine sleep and self-harm risk in adolescents using a micro-longitudinal design, these preliminary findings should be considered with caution and replication studies are encouraged.

Each of these studies has advanced our understanding of the link between symptoms of sleep disturbance and subsequent self-harm risk during adolescence. Taken together they contribute to four clear take home messages:

Take home message 1: Sleep problems and self-harm are public health issues that warrant further attention in adolescents living in Scotland.

Take home message 2: Specific aspects of sleep (insomnia symptoms and poor sleep quality) predict self-harm risk – but the relationship is complex. Specifically, understanding of the link is complicated by the fact that effects are not uniform across all sleep parameters and disturbances, and whilst disturbed sleep predicts self-harm risk over a period of months – this does not facilitate short-term prediction of self-harm thoughts and behaviours.

Take home message 3: Defeat and internal entrapment (but not external entrapment) are part of the psychological pathway that gives rise to self-harm risk during adolescence.

Take home message 4: These theoretically salient psychological constructs explain the relationship between insomnia symptoms and self-harm.

Each of these our investigations and take home messages has implications for self-harm theory as well as measurement, policy and practice (in educational settings).

7.2. Implications

7.2.1. Refining theoretical conceptualisations of self-harm

7.2.1.1. The role of defeat and entrapment in understanding self-harm risk during adolescence.

There has been consistent support for perceptions of defeat and entrapment within pathways to self-harm (Littlewood et al., 2016b; Siddaway et al., 2015; Taylor et al., 2011). However, these conclusions have almost exclusively been based on studies that have focused solely on adults. This is problematic as adolescence represents a high-risk period for the onset and persistence of self-harm, and, due to the unique nature of this developmental period (Blakemore, 2018), we cannot assume that previous findings will apply directly to young people. Consequently there was a need to investigate the nature of these theoretically salient indicators of self-harm risk during adolescence.

The investigations presented in this thesis resulted in three key findings concerning the role of defeat and entrapment within self-harm theory. First, a novel investigation of the factor structure of the Entrapment Scale (Gilbert & Allen, 1998) demonstrated that perceptions of entrapment should be conceptualised as bi-

dimensional (i.e., internal vs. external entrapment), rather than as a unified constructs. There remains contention within the extant literature as to whether entrapment is an overarching construct or whether it is best conceptualised as having two specific subcomponents (i.e., internal and external) (Cramer et al., 2019; Tucker et al., 2016). A better grasp of this psychological construct in adolescents, and how it is best measured is fundamental if we are to accurately understand the role of entrapment as a driver of self-harm risk during this developmental period. Our finding guided our remaining analyses and has implications for future research. More specifically, findings support the assertion that researchers should examine specific subtypes of entrapment in their own right during adolescence (rather than conducting analyses with a total entrapment score). This finding is in line with recent research conducted in cross-cultural samples of young adults (Cramer et al., 2019).

Second, in establishing that internal and external entrapment can be examined separately during adolescence, we were able to obtain a more refined understanding of the role of defeat and entrapment in relation to self-harm risk. More specifically, young people experiencing increased perceptions of defeat and internal entrapment were more likely to report subsequent self-harm thoughts and behaviours. However, associations with external entrapment were not significant.

This finding replicated across different research designs, measures, and timescales (i.e. months vs. same day) and suggests that perceiving thoughts and feelings to be inescapable is a key driver of self-harm risk during adolescence. This reinforces results from previous research indicating that internal entrapment appears to be more harmful than feeling trapped by external circumstances or factors (Cramer et al., 2019; De Beurs et al., 2019, Owens et al., 2017). Moreover, our findings extend existing literature by examining whether entrapment mediates the

link between defeat and self-harm risk in an adolescent sample (a prediction generated based on the IMV). Our results provide support for this pathway, and offer preliminary evidence to suggest that the IMV could be a useful framework in furthering our understanding of self-harm risk during adolescence.

Third, in examining the central components of the IMV using a micro-longitudinal investigation (for the first time), we provided novel insights into the nature of defeat and entrapment in adolescent daily life. Perceptions of defeat, internal entrapment, and external entrapment exhibited substantial within-person variation across the seven-day data collection period. This perspective highlights that feelings of defeat and entrapment are dynamic, and support the notion that defeat and internal entrapment (but not external entrapment) are proximal predictors of self-harm risk (Dhingra et al., 2016; O'Connor & Kirtley, 2018) during adolescence. In doing so we provide further support for the predictions of the IMV. The results of our micro-longitudinal investigation supports the assertion that internal entrapment is a key driver of short-term self-harm risk during adolescence. By emphasising the role of internal entrapment within this pathway, our work is relevant to the conceptualisation of acute suicide crisis syndrome in young people. There is growing evidence for this acute mental state being associated with imminent suicidal behaviour, and increased feelings of entrapment have been highlighted as core component of the syndrome (Li et al., 2018). Future research should aim to provide a more fine-grained understanding of these relationships by examining fluctuations in these perceptions across a shorter timeframe (i.e. every 4 – 8 hours (Kleiman et al., 2017)), and advance understanding regarding which factors predict variation. Further research should investigate the characteristics of acute suicide syndrome in adults. Taken together, our findings support the assertion that defeat and internal

entrapment are key psychological drivers that promote self-harm thoughts and behaviours.

7.2.1.2. Symptoms of sleep disturbance as markers of risk for self-harm in young people: Highlighting the role of defeat and entrapment

To date, no theoretical frameworks account for the role of symptoms of sleep disturbance within self-harming and suicidal pathways. Findings from our systematic review demonstrate that symptoms of sleep disturbance are associated with increased vulnerability to self-harming and suicidal thoughts and behaviours. Extending the existing literature (using a validated measure of insomnia and a prospective research design), the findings from this thesis indicate that clinically salient insomnia symptoms confer increased risk of subsequent self-harm thoughts and behaviours. Further, our results demonstrate that, young people experiencing symptoms of insomnia are more likely to report either the onset or repetition of self-harm behaviours during a six-month follow-up period. These findings provide evidence to suggest that insomnia symptoms would be a valuable addition to theoretical frameworks that seek to map out the complex pathways leading to self-harm and suicide in young people.

As noted in Chapter 1, the IMV model provides the most comprehensive account of the processes involved in the development of self-harm thoughts and behaviours. However, it is still relatively new and not exhaustive. For that reason, a need to investigate the role of novel and modifiable factors, within the context of the IMV was highlighted to support refinement of the framework. The findings presented in this thesis suggest that symptoms of insomnia could be a candidate for inclusion in the IMV. More specifically, our results place these symptoms as a background

vulnerability factor within the pre-motivational phase of this tripartite model. This stage describes the biopsychosocial context in which vulnerability factors and triggering events interact and lead to the emergence of proximal psychological states (defeat and entrapment). Experiencing these psychological states may lead an individual to develop an intention to harm themselves.

The assertion that insomnia could be placed within the pre-motivational phase (and therefore is most likely to represent a distal risk factor for self-harm) is supported by two pieces of evidence presented within this thesis. First, our findings support the multi-step hypothesised pathway derived from the IMV, whereby insomnia symptoms act as a background factor that triggers perceptions of defeat, and defeat is associated with feelings of internal entrapment that are linked to the development of subsequent self-harm thoughts (Figure 7.2). Second, within our micro-longitudinal investigation, no specific aspects of sleep disturbance predicted the occurrence of self-harm thoughts or behaviours the following day. These findings indicate that disturbed sleep may represent an underlying vulnerability for self-harm risk, rather than being a proximal predictor. Alternatively, it is possible that the cumulative impact of nocturnal and daytime insomnia symptoms is necessary to increase risk of self-harm. Contrary to the school-based prospective study, our micro-longitudinal investigation placed an isolated focused on night-time insomnia symptoms, and did not consider the impact of these symptoms on daytime functioning in relation to next-day self-harm thoughts and behaviours. As our micro-longitudinal investigation is the first of its kind, these findings require replication. Therefore, caution should be taken when considering these results in relation to self-harm theory. Moving forwards, research should take two complimentary directions. First, investigations should focus on ascertaining whether specific aspects of

insomnia drive self-harm risk over time (e.g., duration, night-time symptoms, and/or impact on daytime functioning), or whether symptoms cumulatively work together to increase the likelihood that a young person will harm themselves. Second, research should determine whether daytime symptoms of insomnia predict next day self-harm thoughts and behaviour.
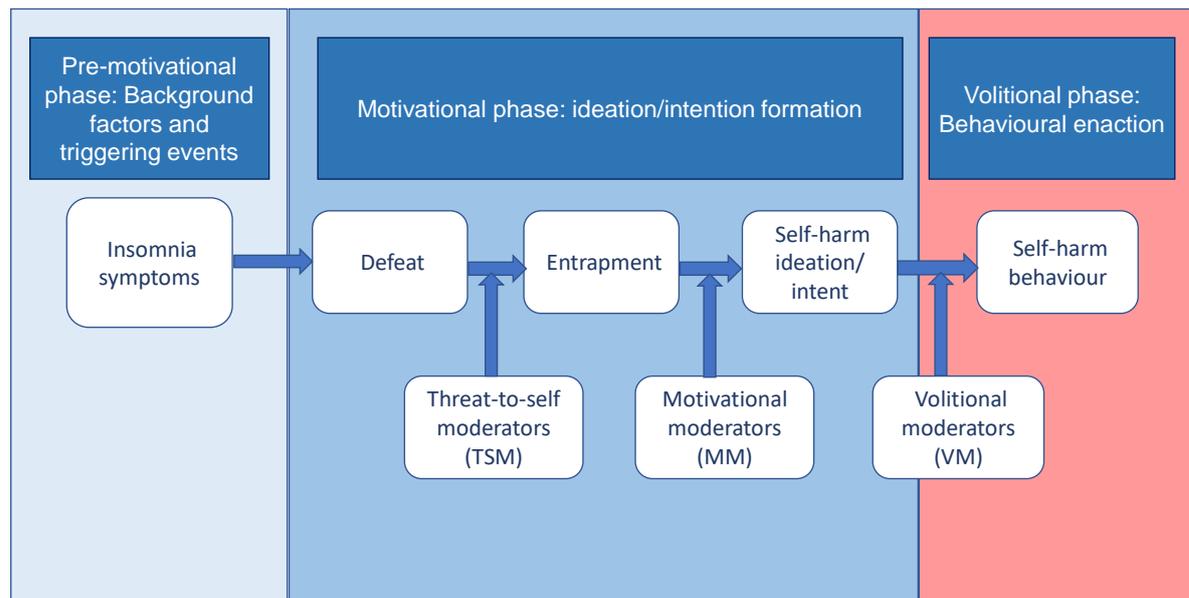
Figure 7. 2. A modified visual representation of the Integrated Motivation-Volitional Model of Suicidal Behaviour (highlighting the hypothesised position of sleep disturbance) (IMV; O'Connor, 2011; O'Connor & Kirtley, 2018)

Converging evidence supports the role of entrapment as a key driver of self-harm risk (O'Connor & Portzky, 2018). Findings from previous research conducted in adult samples indicate that entrapment may play an important role in the association between symptoms of sleep disturbance and self-harm thoughts and behaviours (Hochard et al., 2015; Littlewood et al., 2016a; Littlewood et al., 2016b; Littlewood et al., 2017; Littlewood et al., 2019). Results presented within this thesis support this pathway in adolescents, and highlights a direct relationship between insomnia symptoms and internal entrapment specifically. The association between

symptoms of this sleep disorder and external entrapment was not significant. These findings suggest that sleep may offer an important escape mechanism specifically from negative thoughts and emotions. Focusing on specific subtypes of entrapment within this thesis has moved this field of research forward and provided a more refined understanding as to why sleep problems may confer increased risk for self-harm.

Our findings support previous research and highlight that the IMV is a useful framework for understanding the relationship between sleep disturbance and self-harm risk during adolescence. This is important as identifying modifiable risk factors for first time and repeat self-harm (and understanding the mechanistic pathways driving these relationships) is necessary to inform the development of evidence based prevention efforts.

7.2.2. Implications for measurement

The research presented in this thesis sought to overcome limitations within the existing literature and in doing so our work has three key implications for measurement in future research.

Firstly, our research emphasised that the relationships between symptoms of sleep disturbance and self-harm risk are not uniform. More specifically, only insomnia symptoms and overall poor sleep quality predicted subsequent self-harm risk (when adjusting for depressive symptoms and history of self-harm). Similarly, within our micro-longitudinal investigation only poor sleep quality and nightmares distress were associated with same-day defeat and internal entrapment respectively. Taken together, these findings emphasise the importance of adolescent sleep researchers incorporating multidimensional assessments when looking to obtain a

refined understanding of the consequences of disturbed during this developmental period. By assessing a range of sleep parameters, it is possible to establish which specific aspects of sleep drive these relationships.

As a result of the ongoing debate regarding the conceptualisation and assessment of entrapment, it was important to establish the factor structure of the Entrapment Scale within an adolescent sample. Our work demonstrated that entrapment is best conceptualised as having two distinct but closely related subcomponents (internal and external). Researchers should use these findings to guide the assessment of entrapment in investigations including adolescents. More specifically, our findings suggest that the subscales of the Entrapment Scale should be considered separately in order to gain a more refined understanding of entrapment as a key driver of self-harm during adolescence. The results of our findings, that internal entrapment but not external entrapment accounted for the link between insomnia and self-harm risk support this by demonstrating the value of this assessment strategy in understanding self-harming pathways during adolescence.

The investigation presented in Chapter 6 is the first to employ micro-longitudinal assessments to understand self-harm risk within daily life. As well as providing key information about where sleep may feature within the timeline or pathway towards to self-harm risk, this research also demonstrated that online daily diaries are an acceptable and feasible method for investigating short-term predictors of self-harm thoughts and behaviours during adolescence. Compliance to the study protocol was high (73%) despite a lack of incentives, and feedback from participants was positive. More specifically, the majority of young people agreed that the questions were clear (83%), that the study duration was acceptable (67%), and that the number of questions was feasible (67%). Further, most participants (68%) stated

that they would be willing to participate in future micro-longitudinal studies. The compliance rates in this study support the inclusion of customising daily diary protocols to adolescents sleep schedules in order to minimise study-related sleep disruption and missing data. Further, a risk assessment procedure was developed that could be applied and adapted to other studies examining self-harm and suicide risk. The findings of our micro-longitudinal investigation demonstrated that sleep disturbance, self-harm risk, and theoretically salient psychological factors varied substantially through the week-long period of data collection. As such, it is important that future work takes these insights into consideration when measuring these constructs as these findings suggest that participants should complete repeated assessments within the context of daily life in order to capture the true nature of these variables, and their interrelations.

7.2.3. Implications for policy and practice

Prevention of self-harm and suicide is a policy priority at a national and international level (Scottish Government, 2018; WHO, 2014). These phenomena are public health concerns of considerable scale during adolescence, and should be tackled using a public health approach. This approach follows a four-step process that is summarised in Figure 7.3. The first step involves defining and monitoring the problem. This involves developing a basic understanding of self-harm by systematically collecting data on the characteristics and magnitude of these issues at a national and international level. The research presented in this thesis makes a small, but nonetheless valuable, contribution to this goal by providing up-to-date information on the proportion of young people experiencing self-harm thoughts and engaging in self-harm behaviours in Scotland. The availability of recent data

gathered within a Scottish context can inform data-driven evidence based policy making at a national level. Our findings demonstrate that self-harm warrants further attention from researchers and policymakers, and highlights that young people in Scotland (particularly adolescent girls) are a group that would benefit from preventative interventions that focus on halting self-harming pathways.
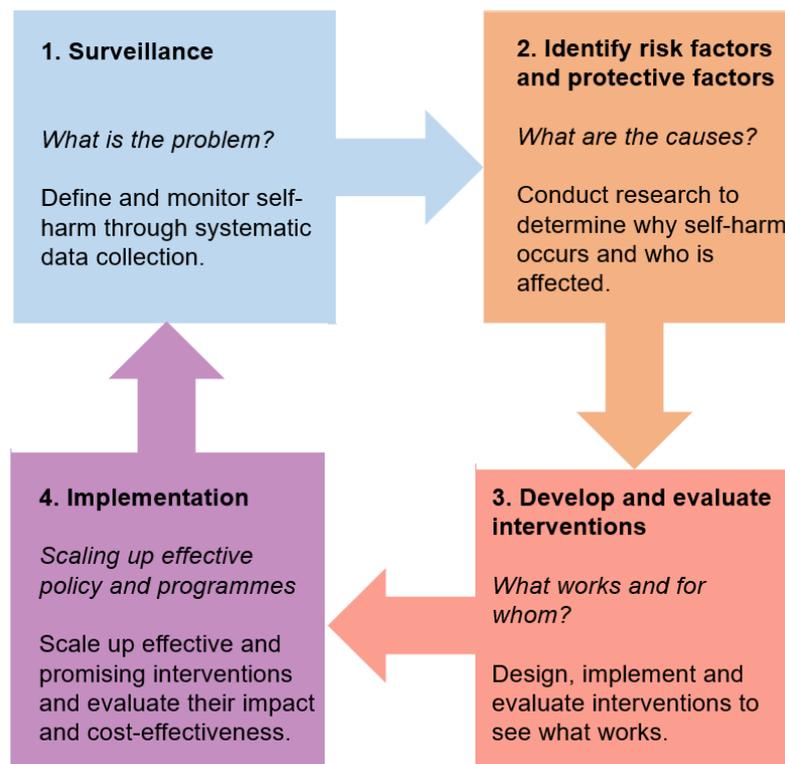
Figure 7. 3. A visual representation of the four-steps of the public health approach to self-harm prevention (adapted from WHO Violence Prevention Alliance public health model)

If self-harm thoughts and behaviour are to be prevented, there is a need to improve understanding regarding the multitude of factors associated with increased risk. In addition, knowledge of the psychological processes that underpin these relationships is required. This is the goal of the second step of the public health approach. The findings presented in this study provide four key pieces of information

that are relevant to this goal. First, young people experiencing clinically salient insomnia symptoms are at increased risk of thinking about, and engaging in, self-harm. Second, symptoms of insomnia were associated with both the onset and repetition of self-harm behaviours. Third, the association between this modifiable aspect of sleep disturbance and self-harm was independent of robust risk factors that cannot be changed (i.e. a history of self-harm thoughts and behaviours). Fourth, perceptions of defeat and internal entrapment accounted for the relationship between insomnia symptoms and self-harm risk.

Gaining a better understanding of how and why self-harm risk emerges during youth highlights key opportunities for prevention and early intervention. These insights can be used to inform the identification and development of empirically supported policies and programmes. This is the goal of the third component of the public health approach, and has been highlighted by the Scottish Government as a priority action in taking mental health and suicide prevention policy forward at a national level (Scottish Government, 2017; 2018). The research presented within this thesis contributes to these strategic objectives by providing evidence to suggest that insomnia symptoms may be one useful indicator in the identification and support of young people at risk of engaging in self-harm thoughts and behaviours.

7.3.1. Sleep as a target for assessing and reducing self-harm risk

Despite converging evidence that sleep problems are a risk factor for self-harm and suicide, no research has investigated efforts to target sleep disturbance in the prevention of self-harming and suicidal thoughts and behaviours during adolescence. A recent review argues that examining the efficacy of sleep improvement interventions in reducing these phenomena should be a priority for

future research (Blake & Allen, 2019). Findings presented within this thesis suggest that sleep problems are an important target for assessment and prevention of self-harm risk. This assertion is strengthened by four key findings from the sleep literature.

First, symptoms of sleep disturbance can be assessed easily and efficiently across a range of settings (clinical, educational and community). Second, sleep patterns and problems are modifiable and therefore amenable to intervention during adolescence (Blake et al, 2017). Third, sleep disturbances are transdiagnostic, and are associated with a range of negative mental health outcomes (Harvey, 2011; 2016). The prevalence of mental health problems is reported to increase during adolescence. As such, addressing transdiagnostic factors such as sleep during this developmental period has the potential to have a positive impact on a range of psychological outcomes (including self-harm). Sleep predicts the onset, maintenance, and relapse of mental health problems (Baglioni et al., 2011; Hertenstein et al., 2019). Given the strong association between mental illness and self-harm, assessment and treatment of sleep problems may indirectly reduce risk of suicide, by preventing the onset of, or supporting recovery from mental health problems (Littlewood & Russell, 2019). Fourth, people are more likely to seek help for sleep problems in comparison to other mental health problems that carry greater stigma (Bernert et al., 2015). As such, engaging in conversations with young people about sleep problems (and associated daytime impairments) may instigate discussions about mental health and provide an opportunity to engage them with further treatment for any co-morbid issues, such as self-harm.

Given that the impact of targeting sleep in the assessment and prevention of self-harm risk remains untested, specific evidence-based suggestions cannot be

made concerning treatment plans. However, the results returned from our programme of research suggest that school-based interventions, which incorporate the assessment and treatment of insomnia symptoms, may be beneficial in terms of reducing risk of self-harm. Although symptoms of sleep disturbance did not predict self-harm the following day, the presence of insomnia symptoms indicates that young people may be at increased risk of harming themselves. Schools provide a natural setting in which to implement a public health oriented continuum of support from school wide (universal), to prevention aimed at groups of young people who are considered to be at higher risk (selective), and more intensive interventions aimed at those with a history of engaging in self-harm (indicated).

7.2.1.1. Assessment

Our findings indicate that young people experiencing clinically salient insomnia symptoms are more vulnerable to self-harm thoughts and behaviours. This emphasises the importance of screening for insomnia disorder as part of a wider risk assessment procedure. The investigations presented in the current thesis show that the Sleep Condition Indicator (Espie et al., 2014) is a quick and efficient way of assessing young people against DSM-V diagnostic criteria within community settings. Given that not all young people with insomnia report experiencing self-harm, screening for these symptoms in young people will likely be most valuable in those already deemed to be at elevated risk (i.e., mental health problems, bereaved by suicide) or in young people with a history of experiencing self-harm thoughts and/or behaviours. Given that, internal entrapment is a key driver of self-harm risk, and specific aspects of sleep disturbance are associated with the perceptions that thoughts and feelings are inescapable; assessing this theoretically salient

psychological construct may indicate which young people reporting symptoms of insomnia are at increased risk.

7.2.2.2. Intervention

Our findings indicated that insomnia symptoms predicted the onset and repetition of self-harm, and that these relationships were independent of self-harm history. Consequently, when considering the role of sleep medicine in the prevention of self-harm thoughts and behaviours, we would argue that restoration of healthy sleep could be beneficial as both an upstream preventative measure in those identified as being at elevated risk of self-harm (selective) and as a treatment target in those with a history of engaging in self-harm (indicated). However, it is important to bear in mind that these hypotheses remain untested and high quality clinical trials evaluating the efficacy of sleep interventions in preventing self-harm in adolescents are clearly needed. Consequently we will now discuss sleep interventions that warrant further investigation within this context.

Although adolescent sleep does lend itself to universal school-based education programmes, findings suggest that increasing knowledge of sleep promoting practices does not necessarily translate into improvements in sleep or mental health outcomes (Blunden, Chapman, & Rigney, 2012; Blunden & Rigney, 2015; Gruber, 2017). Instead evidence suggests that targeted interventions with active components (that incorporate cognitive behavioural principles) may be the best approach (Blake et al., 2016), especially when delivered to those who are already experiencing early signs of sleep and/or mental health problems (Blake et al., 2018; Wensing, Bosch, & Grol, 2010). This may also be the case for those at elevated risk of engaging in first time or repeat self-harm.

Meta-analytic data supports the role of cognitive behavioural therapy as the first line treatment for adolescent sleep problems (and co-morbid depressive and anxious symptomology) (Blake et al., 2017). Most recently, a randomised controlled trial evaluated the effectiveness of a seven-week cognitive behavioural and mindfulness-based sleep group intervention (Blake et al., 2018). This intervention had been tailored to address the developmentally specific barriers that make it challenging to achieving healthy sleep during adolescence, and was shown to be associated with improvements in a range of sleep disturbances and mental health outcomes. Further analysis has demonstrated that improvements in cognitive and somatic pre-sleep arousal as a result of the intervention contributed to improvements in subjective sleep quality and anxiety. This finding is particularly relevant when considering the interrelationships between insomnia symptoms, internal entrapment and self-harm risk within this thesis. Cognitive hyperarousal in this context refers to intrusive pre-sleep thoughts, and could be related to adolescent's perceiving their thoughts as inescapable. As such, it could be hypothesised that reductions in cognitive hyperarousal could lessen feelings of internal entrapment and ultimately influence self-harm risk.

Taken together, it can be hypothesised that assessing and targeting symptoms of sleep disturbance may increase resilience against the onset and persistence of self-harm. Whilst we have highlighted potential sleep-related avenues for prevention, the role of adolescent sleep interventions within this context remains untested. This is an important direction for future research.

7.3. Overarching strengths and limitations of the work presented in this thesis

The specific strengths and limitations of individual investigations have been presented within their respective chapters. Here, the overarching strengths and limitations of the programme of research conducted as part of this PhD are discussed.

7.3.1. Overarching strengths

The research programme presented within this thesis was conducted sequentially. This was advantageous as the findings from each study could be utilised to meaningfully inform the aims and research questions of the subsequent investigation. The systematic review provided an overview of the existing evidence base examining the relationship between sleep disturbance and self-harm during adolescence. This piece of work highlighted the methodological strengths, weaknesses, and challenges within this burgeoning field of research. In doing so, a research agenda was developed with this aim of providing a more nuanced understanding of the relationship. The investigations detailed in subsequent chapters sought to overcome key methodological limitations in the field.

The six-month prospective investigation emphasised the benefit of taking a multidimensional approach to sleep assessment, the importance of controlling for history of self-harm, and also highlighted insomnia symptoms, defeat, and internal entrapment as indicators of future self-harm risk during adolescence. Next, the micro-longitudinal investigations sought to determine whether these indicators would have short-term predictive utility and be valuable targets in highlighting those at imminent risk of self-harm thoughts and behaviour. Whilst defeat and entrapment were shown to be proximal predictors of self-harm risk, symptoms of sleep disturbance were not. This highlights the advantage of employing different

methodologies sequentially and examining varying time frames. If we were to have

moved directly from the systematic review to the micro-longitudinal investigation we

could have made the incorrect assumption that specific aspects of sleep are not

related to self-harm risk. Instead, we have provided evidence to suggest that

insomnia symptoms likely represent a background vulnerability factor. By taking this

multi-step sequential approach we have been able to establish a more nuanced

picture of the relationship between sleep disturbance, self-harm risk and entrapment

that has potential implications for future research, theory, and practice.

Research has consistently demonstrated that the vast majority of adolescent

self-harm occurs "hidden" in the community, and does not come to the attention of

clinical services (Fortune, Sinclair, Hawton, 2008; Ystgaard et al., 2009; Madge et

al., 2008). As such, insights gained from clinical samples cannot necessarily be

directly applied to young people engaging in self-harm who do not seek support from

health professionals. Given the sizeable problem of community-occurring self-harm,

an additional strength of our research is the decision to recruit our participants from a

community-based setting. In doing so we have provided valuable information

regarding the scale of adolescent self-harm in Scotland, and have identified

modifiable targets that could be incorporated in wider risk assessment and

preventative school-based programmes.

7.3.2. Overarching limitations

The studies detailed in this thesis have relied solely on self-report measures.

Therefore, our understanding of the links between sleep problems and self-risk

during adolescence is based entirely on an adolescent's subjective experiences of

these phenomena. As a result, prevalence figures are susceptible to inaccuracies

(overestimation or underestimation) due to potential recall bias, socially desirable answers, or failure to disclose as a consequence of experiencing public or self-harm stigma or shame. For example, many people with insomnia exhibit sleep-state misperception (the phenomenon whereby individuals overestimate their sleep onset latency and underestimate their total sleep time) (Harvey & Tang, 2012). However, the use of self-report measures is common within this field of research (Scott & Woods, 2019) given that this form of assessment affords researchers the opportunity to collect data from large samples within a limited time-period. Our findings provide valuable insights into the adolescents' own experiences of sleep and self-harm, as well as their subjective feelings of defeat and entrapment but future research should also consider incorporating objective measures of sleep.

As our findings were based solely on self-report measures we were unable to investigate whether symptoms of Delayed Sleep Phase Disorder (DSPD) confers increased risk for self-harm. DSPD predominantly affects adolescents and young adults, and prevalence rates for young people range from 1% to 16% depending on the operationalisation of the disorder that has been employed (Lovato et al., 2013; Gradisar & Crowley, 2013). Accurate diagnosis requires the combination of data collected using longitudinal actigraphy (an objective measure of sleep timing) and the completion of a prospective sleep diary. This was not feasible within the context of our investigations. There is an overlap between DSPD symptoms and sleep onset insomnia (specifically on school nights) (Crowley & Gradisar, 2013). Consequently, future investigations should aim to include both subjective and objective measures of sleep in order to tease out whether adolescents with an extremely delayed sleep schedule are at an increased risk of self-harm thoughts and behaviours.

All of the young people that participated in the research presented within this thesis were recruited from mainstream secondary schools in Scotland. Young people who engage in self-harm are more likely to be absent from school, and so it is possible that those who are at most at risk were not included within the research or are lost to attrition. In line with this assertion, participants from our six-month prospective study who did not complete measures at follow up were more likely to report having engaged in self-harm at some point in their lifetime. Whilst our findings are not applicable to those who do not attend school, a significant minority of pupils did report engaging in self-harm during the six month follow up period, and others with a history of self-harm did remain engaged with the study. Further, 20% of the young people who complied with our micro-longitudinal investigation protocol reported a history of harming themselves. These findings suggest that school-based studies of self-harm can provide valuable insights, and that interventions delivered in schools have the potential to reach many young people who are at increased risk of harming themselves.

7.4. Future research directions

Despite the contributions of the programme of research presented in this thesis, a number of unanswered questions remain regarding how and why sleep problems are related to self-harm risk during adolescence. We now highlight some specific areas that warrant further investigations.

- All investigations examining the relationship between sleep and self-harm during adolescence have relied solely on quantitative measures. Research employing mixed methods would be a powerful addition to this field of research. There is a clear need to capture the voices of adolescents with lived

experience of sleep disturbance and self-harm in order to understand to build a more refined and developmentally specific understanding of this relationship. This would be achieved by investigating young people's perceptions of the impact that sleep disturbance has on their daily lives, and their beliefs about the role of disturbed sleep in relation to self-harm. Doing this may highlight alternative mediating pathways that can be tested in future work.

- We examined the relationship between symptoms of sleep disturbance and self-harm during the academic year, and purposefully did not collect data in close temporal proximity to exam periods (to avoid the potential confounding influence of stress). Given that several key transitions occur during adolescence it would be useful to investigate relationships between sleep problems, self-harm and psychological factors within the context of these changes. Transitions of interest could include collecting data during the academic year vs. school holidays, as well as during and out with exam periods. This research may highlight key points of intervention whether young people are at increased risk of self-harm.

- This research programme focused on adolescents who attend school. A logical next step would be to would to focus on high risk populations for the onset and repetition of self-harm thoughts and behaviours in order to uncover any nuances in the relationship. This would be particularly beneficial in specific populations where young people face additional barriers to obtaining good sleep (e.g., looked after young people or detained adolescents). Research of this nature would provide the opportunity to establish whether the findings presented within this thesis replicate in more high-risk groups of

adolescents or whether there are differences in terms of the aspects of sleep

disturbance that drive risk, or in the psychological factors driving this

relationships. For example, it may be that external entrapment is more

relevant in detained adolescents. These findings would highlight whether risk

assessments and intervention efforts would need to be tailored to specific

subpopulations during adolescence.

7.5. Reflections on conducting research within the field of self-harm

This thesis comprised a systematic review, six-month prospective study, and a

micro-longitudinal investigation. Conducting two studies that involved recruiting

participants from schools provided an excellent opportunity to investigate the role of

sleep disturbance as a risk factor for self-harm thoughts and behaviours that occur

within the community.

Research investigating suicide and self-harm is sensitive in nature and it is

important to consider potential ethical challenges during the planning stages. One

challenge faced within the current PhD was balancing participants' right to privacy

and anonymity with risk assessment procedures within the six-month prospective

study. Given the importance of gathering information regarding the scale of self-harm

in Scotland, the decision was taken to collect data anonymously. This meant that we

were not able to identify participants, and, therefore, if anyone was a risk of engaging

in self-harm we were unable to support them. It was believed that this would

encourage honesty and was made clear to participants, parents and schools within

the letters and information sheets provided. As participant well-being is imperative,

all participants - including those that withdrew from taking part - were provided with

an information sheet listing the different options available to them if they were

experiencing any of the problems raised in the survey or having thoughts of self-harm or suicide. Sources of advice and support for the pupils were listed including family, friends, GP and a range of helplines relevant to the issues raised in the questionnaire. Where requested, these information sheets indicated specific sources of help within the school (e.g., contact details for a staff member who could provide confidential help). School guidance teams were also be informed of the nature of the questions asked in the study and were prepared for the possibility that pupils may seek help if they were experiencing problems, or were intending to harm themselves. Where anonymity is implemented in future studies, a robust risk assessment protocol should be put in place.

Another important consideration when conducting research within the field of self-harm is researcher competency. It is likely that most early career researchers will not have received formal clinical training prior to conducting a programme of PhD research within this area. Although data was collected anonymously, there was the potential that a young person may directly approach me for support during the school-based investigation. In addition, the risk assessment protocol within the micro-longitudinal investigation required that I contact participants if they surpassed the non-compliance threshold. At this point, participants had the opportunity to disclose if they were at risk of harming themselves. Consequently, I took the decision to undertake relevant training in order that I was able to support young people at risk of self-harm, and was aware of appropriate local organisations to signpost young people to. As well as decreasing risk of harm to participants, this increased my confidence in conducting research in this area.

Researcher wellbeing is another important consideration when conducting investigations within the field of suicide and self-harm. It is likely that collecting and

collating data regarding self-harm thoughts and behaviours from young people will impact on researcher wellbeing at some stage (especially when combined with the challenges of school research). In order to manage my wellbeing throughout my PhD, I adopted three key strategies. Firstly, it was important to bear in mind that effectively managing self-harm is a key component of suicide prevention strategies. I am passionate about supporting young people, and research of this nature teaches us valuable lessons that have the potential to make a difference to young people's lives in the future. Also, it is a privilege to have young people share their experiences of self-harm, especially given the hidden nature of this phenomena. Several adolescents took part in the research as they believed it had the potential to help other young people.

Secondly, it was important to incorporate discussions regarding researcher wellbeing into supervision meetings and annual reviews. My supervisory team and I had regular discussions about well-being throughout my PhD. Finally, I learned the importance of being part of a supportive network of early career researchers within this field of research. Having a network where you can talk to people who are doing, or have completed, a PhD is extremely valuable in that it provides opportunity to learn from each other and share experiences with regards to the research process (both practically and in terms of wellbeing),. Being part of netECR (an international network of early career researchers in suicide and self-harm) provided an excellent opportunity to be part of a supportive virtual lab, and has been an invaluable part of my PhD.

It is regularly emphasised that obtaining ethical approval for research investigating self-harm is challenging. Given that I was conducting research regarding a sensitive topic and with young people below the age of 16, my research

was required to undergo a more stringent ethical approval process. My application

required some minimal amendments but the process was straightforward. On the

other hand, when I submitted the same application to the ethics boards of local

education authorities in Scotland, a number of concerns were raised. These

anxieties most often centred round the concern that asking young people about their

engagement in self-harm would lead to an increase in the likelihood that they would

go on to harm themselves. Despite the application providing evidence to the

contrary, several applications to local education authorities were rejected on this

basis.

The research presented within this thesis also provided an opportunity to learn

about the processes and challenges involved in conducting research in collaboration

with schools. Recruiting participants from schools is a slow, but ultimately rewarding

process. In order to work with young people in Scotland, permission has to be

requested from a hierarchy of gatekeepers (local education authorities, head

teachers, and parents). Communicating with gatekeepers requires flexibility and

persistence, and it is important to account for potential delays in responses within the

planned time-frame of the study. Conducting research within a school environment is

also challenging due to the busy nature of education. Main barriers to data-collection

included school holidays and exam timetables. Often participation in one study

required one member of staff to demonstrate a keen interest in mental health or to

have concerns about self-harm within their schools, and consequently agree to take

part in the research. It was rewarding to work with these teachers.

Whilst I was able to recruit a sufficient number of pupils to take part in my

research, a substantial number of schools did not accept the invitation to take part.

The main reasons for not taking part were that there wasn't sufficient time and

resources, schools had taken part in similar research, or they were uncomfortable with the research topic. This highlighted that suicide and self-harm are still associated with stigma, even in those who are working with high risk populations. In addition, it highlighted the need for group research projects, or multi-centre investigations to reduce the burden on schools and increase the potential for adequately powered research in Scotland. This would be particularly beneficial for research interested in uncovering differences between specific self-harm subgroups (e.g. recency, duration, methods etc.)

Due to ethical constraints and the fact that the majority of participants were under the age of 16 we were required to employ gold standard active parental consent procedures. However, we faced two issues with this. First, schools were less likely to participate with these constraints in place, as it required them to invest more time and resources into the project. Second, this led to a very low response rate. For example, in one school over three hundred parental consent forms were distributed and only three were returned. Based on feedback from schools, we requested an amendment to our original ethics application in order that we could employ passive parental consent. The concern here was the parents would not receive the letters and that young people would be participating in this research without their knowledge. As such, a protocol was put in place whereby parents received the letters and consent forms via email, and were also sent and SMS message to notify them of the email. This led to a significant increase in the number of young people that were able to participate in the research. As such, researchers in this field should try to make a strong argument for passive parental concern in the first instance to ensure that time and resources are used efficiently. However, a

protocol should be in place to increase the likelihood that the information is received by parents.

The use of online-daily diaries was a valuable method of data collection and provided key insights into the relationship between sleep and self-harm risk. It is recommended that researchers undertake training in applying these techniques and analysing the data that is collected. Such training is available from KU Leuven from world leading experts in micro-longitudinal assessment. This training provided a strong foundational knowledge that benefit me in the design of the study, and supported the challenging analytical methods that were applied. Whilst feedback was not gathered in relation to the first school-based study, it was deemed important to collect this following the micro-longitudinal investigation (as it was the first time that it had been employed to assess self-harm risk in young people). Feedback was obtained in two way. First, the online daily diary was piloted in a sample of ten young people and surveys were modified on the basis of their suggestions. Second, a short feedback survey was completed following completion of the micro-longitudinal protocol. The majority of feedback was positive. However, one criticism that was consistent across the pilot and the feedback survey was that there were too many questions to complete. It is important to consider this in future research. Further, participants noted that incentives were likely to increase compliance to future research protocols.

A number of important lessons were learned during the completion of this research that will undoubtedly benefit my future work in the area. However, in hindsight I would have done two things differently. First of all, in future research I would aim to involve young people at all stages of the research process including planning and dissemination. No young people contributed to the planning of the six-

month prospective studies, and whilst they were involved in the pilot of the micro-longitudinal study, it would be particularly beneficial to learn from their valuable insights throughout. Secondly, whist novel insights were provided by the varied methods used within this thesis, different individuals participated within both prospective investigations. This mean that increased time and resources were invested in recruitment and that we were unable to make conclusions long-term and short-term predictions within the same individuals. It would have been particularly useful to employ a natural history research design and follow the same individuals over time. Future research should aim to do this, whilst incorporating mixed-methods (quantitative and qualitative).

7.6. Conclusion

Overall, the research presented in this thesis targeted gaps in understanding and provided novel insights into the specific aspects of sleep disturbance associated with self-harm risk and the psychological factors that account for this relationship. These findings have implications for researchers, educators, healthcare professionals and policy makers. More specifically, with replication, results have the potential to enhance theoretical conceptualisations of self-harm, support more accurate and efficient future research in the area, and inform specific evidence-based risk assessment and prevention efforts. The research presented in this thesis provides the most refined understanding of these relationships to date within the unique context of adolescence, and adds to the growing evidence base pointing to a role for sleep medicine in preventing self-harm and suicide.

References

Ahrberg, K., Dresler, M., Niedermaier, S., Steiger, A., & Genzel, L. (2012). The interaction between sleep quality and academic performance. *Journal of psychiatric research, 46*(12), 1618-1622.

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes, 50*(2), 179-211.

Alfano, C. A., Ginsburg, G. S., & Kingery, J. N. (2007). Sleep-related problems among children and adolescents with anxiety disorders. *Journal of the American Academy of Child & Adolescent Psychiatry, 46*(2), 224-232.

Altangerel, U., Liou, J.-C., & Yeh, P.-M. (2014). Prevalence and predictors of suicidal behavior among Mongolian high school students. *Community mental health journal, 50*(3), 362-372.

Alves Junior, C. A. S., Nunes, H. E. G., de Andrade Gonçalves, E. C., & Silva, D. A. S. (2016). Suicidal behaviour in adolescents: Characteristics and prevalence. *Journal of Human Growth and Development, 26*(1), 88-94.

An, H., Ahn, J.-h., & Bhang, S.-y. (2010). The association of psychosocial and familial factors with adolescent suicidal ideation: A population-based study. *Psychiatry research, 177*(3), 318-322.

Andover, M. S., & Morris, B. W. (2014). Expanding and clarifying the role of emotion regulation in nonsuicidal self-injury. *The Canadian Journal of Psychiatry, 59*(11), 569-575.

Andover, M. S., Morris, B. W., Wren, A., & Bruzzese, M. E. (2012). The co-occurrence of non-suicidal self-injury and attempted suicide among adolescents: distinguishing risk factors and psychosocial correlates. *Child and adolescent psychiatry and mental health, 6*(1), 11.

Andrade, M. M., Benedito-Silva, A. A., Domenice, S., Arnhold, I. J., & Menna-Barreto, L. (1993). Sleep characteristics of adolescents: a longitudinal study. *Journal of Adolescent Health, 14*(5), 401-406.

Arensman, E., Corcoran, P., & Fitzgerald, A. P. (2011). Deliberate self-harm: Extent of the problem and prediction of repetition. *International Handbook of Suicide Prevention: Research, Policy and Practice. Chichester: John Wiley & Sons*, 119-132.

Arora, T., Broglia, E., Thomas, G. N., & Taheri, S. (2014). Associations between specific technologies and adolescent sleep quantity, sleep quality, and parasomnias. *Sleep medicine, 15*(2), 240-247.

American Association of Sleep Medicine. (2014). *International classification of sleep disorders* (M. Sateia Ed. 3rd Edition ed.). Darien, IL.

American Psychological Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*: American Psychiatric Pub.

Baglioni, C., Battagliese, G., Feige, B., Spiegelhalder, K., Nissen, C., Voderholzer, U., . . . Riemann, D. (2011). Insomnia as a predictor of depression: a meta-analytic evaluation of longitudinal epidemiological studies. *Journal of affective disorders, 135*(1-3), 10-19.

Bandel, S. L., & Brausch, A. M. (2020). Poor sleep associates with recent nonsuicidal self-injury engagement in adolescents. *Behavioral sleep medicine, 18*(1), 81-90.

Barnes, M., Davis, K., Mancini, M., Ruffin, J., Simpson, T., & Casazza, K. (2016). Setting adolescents up for success: promoting a policy to delay high school start times. *Journal of school health, 86*(7), 552-557.

Bartel, K. A., Gradisar, M., & Williamson, P. (2015). Protective and risk factors for adolescent sleep: a meta-analytic review. *Sleep medicine reviews, 21*, 72-85.

Barzilay, S., & Apter, A. (2014). Psychological models of suicide. *Archives of suicide research, 18*(4), 295-312.

Baum, K. T., Desai, A., Field, J., Miller, L. E., Rausch, J., & Beebe, D. W. (2014). Sleep restriction worsens mood and emotion regulation in adolescents. *Journal of Child*

Psychology and Psychiatry, 55(2), 180-190.

Beck, A. T., Kovacs, M., & Weissman, A. (1979). Assessment of suicidal intention: the Scale for Suicide Ideation. *Journal of consulting and clinical psychology, 47*(2), 343.

Becker, S. P., Sidol, C. A., Van Dyk, T. R., Epstein, J. N., & Beebe, D. W. (2017). Intraindividual variability of sleep/wake patterns in relation to child and adolescent functioning: A systematic review. *Sleep medicine reviews, 34*, 94-121.

Belicki, K. (1992). Nightmare frequency versus nightmare distress: relations to psychopathology and cognitive style. *Journal of abnormal psychology, 101*(3), 592.

Berger, A. T., Widome, R., & Troxel, W. M. (2018). School start time and psychological health in adolescents. *Current sleep medicine reports, 4*(2), 110-117.

Bernert, R. A., Kim, J. S., Iwata, N. G., Moscowitz, A., & Horn, M. (2015). *Perceived stigma toward mental health in association with sleep disturbances and as an acute.* Paper presented at the Sleep.

Bernert, R. A., Kim, J. S., Iwata, N. G., & Perlis, M. L. (2015). Sleep disturbances as an evidence-based suicide risk factor. *Current psychiatry reports, 17*(3), 15.

Bishop, T. M., Simons, K. V., King, D. A., & Pigeon, W. R. (2016). Sleep and suicide in older adults: an opportunity for intervention. *Clinical therapeutics, 38*(11), 2332-2339.

Bjarnason, T., & Thorlindsson, T. (1994). Manifest predictors of past suicide attempts in a population of Icelandic adolescents. *Suicide and Life-Threatening Behavior, 24*(4), 350-358.

Blagrove, M., Farmer, L., & Williams, E. (2004). The relationship of nightmare frequency and nightmare distress to well-being. *Journal of sleep research, 13*(2), 129-136.

Blake, M., Waloszek, J. M., Schwartz, O., Raniti, M., Simmons, J. G., Blake, L., . . . Dudgeon, P. (2016). The SENSE study: Post intervention effects of a randomized controlled trial of a cognitive–behavioral and mindfulness-based group sleep improvement intervention among at-risk adolescents. *Journal of consulting and clinical psychology, 84*(12), 1039.

Blake, M. J., & Allen, N. B. (2019). Prevention of internalizing disorders and suicide via adolescent sleep interventions. *Current opinion in psychology*.

Blake, M. J., & Allen, N. B. (2019). Prevention of internalizing disorders and suicide via adolescent sleep interventions. *Current opinion in psychology*.

Blake, M. J., Sheeber, L. B., Youssef, G. J., Raniti, M. B., & Allen, N. B. (2017). Systematic review and meta-analysis of adolescent cognitive–behavioral sleep interventions. *Clinical child and family psychology review, 20*(3), 227-249.

Blake, M. J., Trinder, J. A., & Allen, N. B. (2018). Mechanisms underlying the association between insomnia, anxiety, and depression in adolescence: Implications for behavioral sleep interventions. *Clinical psychology review, 63*, 25-40.

Blakemore, S.-J. (2018). *Inventing ourselves: The secret life of the teenage brain*: Hachette UK.

Blank, M., Zhang, J., Lamers, F., Taylor, A. D., Hickie, I. B., & Merikangas, K. R. (2015). Health correlates of insomnia symptoms and comorbid mental disorders in a nationally representative sample of US adolescents. *Sleep, 38*(2), 197-204.

Blunden, S., & Galland, B. (2014). The complexities of defining optimal sleep: empirical and theoretical considerations with a special emphasis on children. *Sleep medicine reviews, 18*(5), 371-378.

Blunden, S., & Rigney, G. (2015). Lessons learned from sleep education in schools: a review of dos and don'ts. *Journal of Clinical Sleep Medicine, 11*(06), 671-680.

Blunden, S. L., Chapman, J., & Rigney, G. A. (2012). Are sleep education programs successful? The case for improved and consistent research efforts. *Sleep medicine reviews, 16*(4), 355-370.

Bonnet, M. H., & Arand, D. L. (2010). Hyperarousal and insomnia: state of the science. *Sleep medicine reviews, 14*(1), 9-15.

Borbély, A. A., Achermann, P., Trachsel, L., & Tobler, I. (1989). Sleep initiation and initial sleep intensity: interactions of homeostatic and circadian mechanisms. *Journal of biological rhythms, 4*(2), 37-48.

Borisenkov, M. F., Perminova, E. V., & Kosova, A. L. (2010). Chronotype, sleep length, and school achievement of 11-to 23-year-old students in northern European Russia. *Chronobiology international, 27*(6), 1259-1270.

Borisenkov, M. F., Tserne, T. A., Panev, A. S., Kuznetsova, E. S., Petrova, N. B., Timonin, V. D., . . . Khokhlov, N. A. (2017). Seven-year survey of sleep timing in Russian children and adolescents: chronic 1-h forward transition of social clock is associated with increased social jetlag and winter pattern of mood seasonality. *Biological Rhythm Research, 48*(1), 3-12.

Borschmann, R., Becker, D., Coffey, C., Spry, E., Moreno-Betancur, M., Moran, P., & Patton, G. C. (2017). 20-year outcomes in adolescents who self-harm: a population-based cohort study. *The Lancet Child & Adolescent Health, 1*(3), 195-202.

Borschmann, R., Stark, P., Prakash, C., & Sawyer, S. M. (2018). Risk profile of young people admitted to hospital for suicidal behaviour in Melbourne, Australia. *Journal of paediatrics and child health, 54*(11), 1213-1220.

Branley-Bell, D., O'Connor, D. B., Green, J. A., Ferguson, E., O'Carroll, R. E., & O'Connor, R. C. (2019). Distinguishing suicide ideation from suicide attempts: Further test of the Integrated Motivational-Volitional Model of Suicidal Behaviour. *Journal of psychiatric research*.

Brent, D. A. (2011). Preventing youth suicide: time to ask how. *Journal of the American Academy of Child & Adolescent Psychiatry, 50*(8), 738-740.

Brunner, R., Kaess, M., Parzer, P., Fischer, G., Carli, V., Hoven, C. W., . . . Apter, A. (2014). Life-time prevalence and psychosocial correlates of adolescent direct self-injurious behavior: A comparative study of findings in 11 European countries. *Journal of Child Psychology and Psychiatry, 55*(4), 337-348.

Bryan, C. J., & Rudd, M. D. (2016). The importance of temporal dynamics in the transition from suicidal thought to behavior. *Clinical Psychology: Science and Practice, 23*(1), 21-25.

Bryant, P. A., Trinder, J., & Curtis, N. (2004). Sick and tired: does sleep have a vital role in the immune system? *Nature Reviews Immunology, 4*(6), 457.

Butler, A. M., & Malone, K. (2013). Attempted suicide v. non-suicidal self-injury: behaviour, syndrome or diagnosis? *The British Journal of Psychiatry, 202*(5), 324-325.

Buysse, D. J. (2014). Sleep health: can we define it? Does it matter? *Sleep, 37*(1), 9-17.

Buysse, D. J., Ancoli-Israel, S., Edinger, J. D., Lichstein, K. L., & Morin, C. M. (2006). Recommendations for a standard research assessment of insomnia. *Sleep, 29*(9), 1155-1173.

Buysse, D. J., Reynolds III, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry research, 28*(2), 193-213.

Calamaro, C. J., Mason, T. B., & Ratcliffe, S. J. (2009). Adolescents living the 24/7 lifestyle: effects of caffeine and technology on sleep duration and daytime functioning. *Pediatrics, 123*(6), e1005-e1010.

Carney, C. E., Buysse, D. J., Ancoli-Israel, S., Edinger, J. D., Krystal, A. D., Lichstein, K. L., & Morin, C. M. (2012). The consensus sleep diary: standardizing prospective sleep self-monitoring. *Sleep, 35*(2), 287-302.

Carskadon, M., Acebo, C., & Seifer, R. (2001). Extended nights, sleep loss, and recovery sleep in adolescents. *Archives italiennes de Biologie, 139*(3), 301-312.

Carskadon, M. A., Mindell, J. A., & Drake, C. (2006). *Sleep in America Poll: Teens.* Washington, DC: National Sleep Foundation.

Carskadon, M. A. (2011). Sleep in adolescents: the perfect storm. *Pediatric Clinics, 58*(3), 637-647.

Carskadon, M. A., Acebo, C., & Jenni, O. G. (2004). Regulation of adolescent sleep. *Ann NY Acad Sci, 1021*, 276-291.

Carskadon, M. A., & Rechtschaffen, A. (2011). Monitoring and staging human sleep. *Principles and practice of sleep medicine, 5*, 16-26.

Carskadon, M. A., Vieira, C., & Acebo, C. (1993). Association between puberty and delayed

phase preference. *Sleep, 16*(3), 258-262.

Castellví, P., Lucas-Romero, E., Miranda-Mendizábal, A., Parés-Badell, O., Almenara, J., Alonso, I., . . . Gili, M. (2017). Longitudinal association between self-injurious thoughts and behaviors and suicidal behavior in adolescents and young adults: A systematic review with meta-analysis. *Journal of affective disorders, 215*, 37-48.

Cerel, J., Brown, M. M., Maple, M., Singleton, M., van de Venne, J., Moore, M., & Flaherty, C. (2019). How many people are exposed to suicide? Not six. *Suicide and Life-Threatening Behavior, 49*(2), 529-534.

Cha, C. B., Franz, P. J., M. Guzmán, E., Glenn, C. R., Kleiman, E. M., & Nock, M. K. (2018). Annual Research Review: Suicide among youth–epidemiology,(potential) etiology, and treatment. *Journal of Child Psychology and Psychiatry, 59*(4), 460-482.

Chein, J., Albert, D., O'Brien, L., Uckert, K., & Steinberg, L. (2011). Peers increase adolescent risk taking by enhancing activity in the brain's reward circuitry. *Developmental science, 14*(2), F1-F10.

Chiu, H.Y., Lee, H.C., Chen, P.Y., Lai, Y.F., & Tu, Y.K. (2018). Associations between sleep duration and suicidality in adolescents: A systematic review and dose–response meta-analysis. *Sleep medicine reviews, 42*, 119-126.

Choquet, M., Kovess, V., & Poutignat, N. (1993). Suicidal thoughts among adolescents: an intercultural approach. *Adolescence, 28*(111), 649.

Choquet, M., & Menke, H. (1990). Suicidal thoughts during early adolescence: prevalence, associated troubles and help-seeking behavior. *Acta Psychiatrica Scandinavica, 81*(2), 170-177.

Chung, M. S., Chiu, H. J., Sun, W. J., Lin, C. N., Kuo, C. C., Huang, W. C., . . . Chou, P. (2014). Association among depressive disorder, adjustment disorder, sleep disturbance, and suicidal ideation in T aiwanese adolescent. *Asia-Pacific Psychiatry, 6*(3), 319-325.

Cohen, S., Doyle, W. J., Alper, C. M., Janicki-Deverts, D., & Turner, R. B. (2009). Sleep habits and susceptibility to the common cold. *Archives of internal medicine, 169*(1), 62-67.

Coolidge, F. L., Segal, D. L., Coolidge, C. M., Spinath, F. M., & Gottschling, J. (2010). Do nightmares and generalized anxiety disorder in childhood and adolescence have a common genetic origin? *Behavior genetics, 40*(3), 349-356.

Cramer, R. J., Rasmussen, S., & Tucker, R. P. (2019). An examination of the Entrapment Scale: Factor structure, correlates, and implications for suicide prevention. *Psychiatry research, 282*, 112550.

Crowley, S. J., Acebo, C., & Carskadon, M. A. (2007). Sleep, circadian rhythms, and delayed phase in adolescence. *Sleep medicine, 8*(6), 602-612.

Crowley, S. J., Tarokh, L., & Carskadon, M. A. (2014). Sleep during adolescence. *Principles and practice of pediatric sleep medicine*, 45-52.

Crowley, S. J., Van Reen, E., LeBourgeois, M. K., Acebo, C., Tarokh, L., Seifer, R., . . . Carskadon, M. A. (2014). A longitudinal assessment of sleep timing, circadian phase, and phase angle of entrainment across human adolescence. *PLoS One, 9*(11), e112199.

Crowley, S. J., Wolfson, A. R., Tarokh, L., & Carskadon, M. A. (2018). An update on adolescent sleep: New evidence informing the perfect storm model. *Journal of adolescence, 67*, 55-65.

Czyz, E., King, C., & Nahum-Shani, I. (2018). Ecological assessment of daily suicidal thoughts and attempts among suicidal teens after psychiatric hospitalization: Lessons about feasibility and acceptability. *Psychiatry research, 267*, 566-574.

Czyz, E. K., Horwitz, A. G., Arango, A., & King, C. A. (2019). Short-term change and prediction of suicidal ideation among adolescents: a daily diary study following psychiatric hospitalization. *Journal of Child Psychology and Psychiatry, 60*(7), 732-741.

Dahl, R. E., & Harvey, A. G. (2007). Sleep in children and adolescents with behavioral and emotional disorders. *Sleep medicine clinics, 2*(3), 501-511.

De Beurs, D., Fried, E. I., Wetherall, K., Cleare, S., O'Connor, D. B., Ferguson, E., . . . O'Connor, R. C. (2019). Exploring the psychology of suicidal ideation: A theory driven network analysis. *Behaviour research and therapy, 120*, 103419.

de la Vega, R., Tomé-Pires, C., Solé, E., Racine, M., Castarlenas, E., Jensen, M. P., & Miró, J. (2015). The Pittsburgh Sleep Quality Index: Validity and factor structure in young people. *Psychological assessment, 27*(4), e22.

de Zambotti, M., Goldstone, A., Colrain, I. M., & Baker, F. C. (2018). Insomnia disorder in adolescence: Diagnosis, impact, and treatment. *Sleep medicine reviews, 39*, 12-24.

Dewald, J. F., Meijer, A. M., Oort, F. J., Kerkhof, G. A., & Bögels, S. M. (2010). The influence of sleep quality, sleep duration and sleepiness on school performance in children and adolescents: A meta-analytic review. *Sleep medicine reviews, 14*(3), 179-189.

Dhingra, K., Boduszek, D., & O'Connor, R. C. (2016). A structural test of the integrated motivational-volitional model of suicidal behaviour. *Psychiatry research, 239*, 169-178.

Do, Y. K., Shin, E., Bautista, M. A., & Foo, K. (2013). The associations between self-reported sleep duration and adolescent health outcomes: what is the role of time spent on Internet use? *Sleep medicine, 14*(2), 195-200.

Dohnt, H., Gradisar, M., & Short, M. A. (2012). Insomnia and its symptoms in adolescents: comparing DSM-IV and ICSD-II diagnostic criteria. *Journal of Clinical Sleep Medicine, 8*(03), 295-299.

Dowrick, P. W., Back, L. T., & Mills, N. C. (2015). School Failure and School Success *Handbook of Adolescent Behavioral Problems* (pp. 395-414): Springer.

Duell, N., Steinberg, L., Icenogle, G., Chein, J., Chaudhary, N., Di Giunta, L., . . . Oburu, P. (2018). Age patterns in risk taking across the world. *Journal of Youth and Adolescence, 47*(5), 1052-1072.

Epstein, S., Roberts, E., Sedgwick, R., Polling, C., Finning, K., Ford, T., . . . Downs, J. (2019). School absenteeism as a risk factor for self-harm and suicidal ideation in children and adolescents: a systematic review and meta-analysis. *European child & adolescent psychiatry*, 1-20.

Espie, C. A., Farias Machado, P., Carl, J. R., Kyle, S. D., Cape, J., Siriwardena, A. N., & Luik, A. I. (2018). The Sleep Condition Indicator: reference values derived from a sample of 200 000 adults. *Journal of sleep research, 27*(3), e12643.

Espie, C. A., Kyle, S. D., Hames, P., Gardani, M., Fleming, L., & Cape, J. (2014). The Sleep Condition Indicator: a clinical screening tool to evaluate insomnia disorder. *BMJ open, 4*(3), e004183.

Ferrey, A. E., Hughes, N. D., Simkin, S., Locock, L., Stewart, A., Kapur, N., . . . Hawton, K. (2016). The impact of self-harm by young people on parents and families: a qualitative study. *BMJ open, 6*(1), e009631.

Fikke, L., Melinder, A., & Landrø, N. (2011). Executive functions are impaired in adolescents engaging in non-suicidal self-injury. *Psychological medicine, 41*(3), 601-610.

Fischer, D., Lombardi, D. A., Marucci-Wellman, H., & Roenneberg, T. (2017). Chronotypes in the US–influence of age and sex. *PLoS One, 12*(6), e0178782.

Fitzgerald, C. T., Messias, E., & Buysse, D. J. (2011). Teen sleep and suicidality: results from the youth risk behavior surveys of 2007 and 2009. *Journal of Clinical Sleep Medicine, 7*(04), 351-356.

Flake, J. K., & Fried, E. I. (2019). Measurement schmeasurement: Questionable measurement practices and how to avoid them.

Fliege, H., Lee, J.-R., Grimm, A., & Klapp, B. F. (2009). Risk factors and correlates of deliberate self-harm behavior: A systematic review. *Journal of psychosomatic research, 66*(6), 477-493.

Forkmann, T., Teismann, T., Stenzel, J.-S., Glaesmer, H., & De Beurs, D. (2018). Defeat and entrapment: more than meets the eye? Applying network analysis to estimate dimensions of highly correlated constructs. *BMC medical research methodology, 18*(1), 16.

Fortune, S., Sinclair, J., & Hawton, K. (2008). Help-seeking before and after episodes of self-

harm: a descriptive study in school pupils in England. *BMC public health, 8*(1), 369.

Franklin, J. C., Ribeiro, J. D., Fox, K. R., Bentley, K. H., Kleiman, E. M., Huang, X., . . . Nock, M. K. (2017). Risk factors for suicidal thoughts and behaviors: a meta-analysis of 50 years of research. *Psychological bulletin, 143*(2), 187.

Fuligni, A. J., Bai, S., Krull, J. L., & Gonzales, N. A. (2019). Individual differences in optimum sleep for daily mood during adolescence. *Journal of Clinical Child & Adolescent Psychology, 48*(3), 469-479.

Galland, B. C., Short, M. A., Terrill, P., Rigney, G., Haszard, J. J., Coussens, S., . . . Biggs, S. N. (2018). Establishing normal values for pediatric nighttime sleep measured by actigraphy: a systematic review and meta-analysis. *Sleep, 41*(4), zsy017.

Gangwisch, J. E., Babiss, L. A., Malaspina, D., Turner, B. J., Zammit, G. K., & Posner, K. (2010). Earlier parental set bedtimes as a protective factor against depression and suicidal ideation. *Sleep, 33*(1), 97-106.

Gardner, M., & Steinberg, L. (2005). Peer influence on risk taking, risk preference, and risky decision making in adolescence and adulthood: an experimental study. *Developmental psychology, 41*(4), 625.

Gau, S.F., & Soong, W.-T. (2003). The transition of sleep-wake patterns in early adolescence. *Sleep, 26*(4), 449-454.

Gau, S.F., & Suen Soong, W.-T. (1999). Psychiatric comorbidity of adolescents with sleep terrors or sleepwalking: a case-control study. *Australian and New Zealand Journal of Psychiatry, 33*(5), 734-739.

Gau, S.F., Shang, C.-Y., Merikangas, K. R., Chiu, Y.N., Soong, W.T., & Cheng, A. T.A. (2007). Association between morningness-eveningness and behavioral/emotional problems among adolescents. *Journal of biological rhythms, 22*(3), 268-274.

Geulayov, G., Casey, D., McDonald, K. C., Foster, P., Pritchard, K., Wells, C., . . . Waters, K. (2018). Incidence of suicide, hospital-presenting non-fatal self-harm, and community-occurring non-fatal self-harm in adolescents in England (the iceberg model of self-harm): a retrospective study. *The Lancet Psychiatry, 5*(2), 167-174.

Giannotti, F., Cortesi, F., Sebastiani, T., & Ottaviano, S. (2002). Circadian preference, sleep and daytime behaviour in adolescence. *Journal of sleep research, 11*(3), 191-199.

Gieselmann, A., Ait Aoudia, M., Carr, M., Germain, A., Gorzka, R., Holzinger, B., . . . Lancee, J. (2019). Aetiology and treatment of nightmare disorder: State of the art and future perspectives. *Journal of sleep research, 28*(4), e12820.

Gilbert, P. (2016). *Depression: The evolution of powerlessness*: Routledge.

Gilbert, P., & Allan, S. (1998). The role of defeat and entrapment (arrested flight) in depression: an exploration of an evolutionary view. *Psychological medicine, 28*(3), 585-598.

Glazebrook, K., Townsend, E., & Sayal, K. (2015). The role of attachment style in predicting repetition of adolescent self-harm: A longitudinal study. *Suicide and Life-Threatening Behavior, 45*(6), 664-678.

Glenn, C. R., Kleiman, E. M., Cha, C. B., Deming, C. A., Franklin, J. C., & Nock, M. K. (2018). Understanding suicide risk within the Research Domain Criteria (RDoC) framework: A meta-analytic review. *Depression and anxiety, 35*(1), 65-88.

Goldstein, T. R., Bridge, J. A., & Brent, D. A. (2008). Sleep disturbance preceding completed suicide in adolescents. *Journal of consulting and clinical psychology, 76*(1), 84.

Gore, F. M., Bloem, P. J., Patton, G. C., Ferguson, J., Joseph, V., Coffey, C., . . . Mathers, C. D. (2011). Global burden of disease in young people aged 10–24 years: a systematic analysis. *The Lancet, 377*(9783), 2093-2102.

Gradisar, M., & Crowley, S. J. (2013). Delayed sleep phase disorder in youth. *Current opinion in psychiatry, 26*(6), 580.

Gradisar, M., Gardner, G., & Dohnt, H. (2011). Recent worldwide sleep patterns and problems during adolescence: a review and meta-analysis of age, region, and sleep. *Sleep medicine, 12*(2), 110-118.

Gradisar, M., & Tilton-Weaver, L. (2018). An introduction to the special issue on sleep.

Gradisar, M., Wolfson, A. R., Harvey, A. G., Hale, L., Rosenberg, R., & Czeisler, C. A.

(2013). The sleep and technology use of Americans: findings from the National Sleep Foundation's 2011 Sleep in America poll. *Journal of Clinical Sleep Medicine, 9*(12), 1291-1299.

Gratz, K. L. (2001). Measurement of deliberate self-harm: Preliminary data on the Deliberate Self-Harm Inventory. *Journal of Psychopathology and Behavioral Assessment, 23*(4), 253-263.

Griffiths, A. W., Wood, A. M., Maltby, J., Taylor, P. J., & Tai, S. (2014). The prospective role of defeat and entrapment in depression and anxiety: A 12-month longitudinal study. *Psychiatry research, 216*(1), 52-59.

Group, A. S. W. (2014). School start times for adolescents. *Pediatrics, 134*(3), 642-649.

Guo, L., Deng, J., He, Y., Deng, X., Huang, J., Huang, G., . . . Lu, C. (2014). Prevalence and correlates of sleep disturbance and depressive symptoms among Chinese adolescents: a cross-sectional survey study. *BMJ open, 4*(7), e005517.

Guo, L., Xu, Y., Deng, J., Huang, J., Huang, G., Gao, X., . . . Zhang, W.-H. (2017). Association between sleep duration, suicidal ideation, and suicidal attempts among Chinese adolescents: The moderating role of depressive symptoms. *Journal of affective disorders, 208*, 355-362.

Harvey, A. G. (2000). Pre-sleep cognitive activity: A comparison of sleep-onset insomniacs and good sleepers. *British Journal of Clinical Psychology, 39*(3), 275-286.

Harvey, A. G. (2002). A cognitive model of insomnia. *Behaviour research and therapy, 40*(8), 869-893.

Harvey, A. G. (2005). Unwanted intrusive thoughts in insomnia.

Harvey, A. G., Hein, K., Dong, L., Smith, F. L., Lisman, M., Yu, S., . . . Buysse, D. J. (2016). A transdiagnostic sleep and circadian treatment to improve severe mental illness outcomes in a community setting: study protocol for a randomized controlled trial. *Trials, 17*(1), 606.

Harvey, A. G., Murray, G., Chandler, R. A., & Soehner, A. (2011). Sleep disturbance as transdiagnostic: consideration of neurobiological mechanisms. *Clinical psychology review, 31*(2), 225-235.

Harvey, A. G., Stinson, K., Whitaker, K. L., Moskovitz, D., & Virk, H. (2008). The subjective meaning of sleep quality: a comparison of individuals with and without insomnia. *Sleep, 31*(3), 383-393.

Harvey, A. G., & Tang, N. K. (2012). (Mis) perception of sleep in insomnia: A puzzle and a resolution. *Psychological bulletin, 138*(1), 77.

Hawton, K., Bergen, H., Cooper, J., Turnbull, P., Waters, K., Ness, J., & Kapur, N. (2015). Suicide following self-harm: findings from the Multicentre Study of self-harm in England, 2000–2012. *Journal of affective disorders, 175*, 147-151.

Hawton, K., Bergen, H., Kapur, N., Cooper, J., Steeg, S., Ness, J., & Waters, K. (2012). Repetition of self-harm and suicide following self-harm in children and adolescents: Findings from the Multicentre Study of Self-Harm in England. *Journal of Child Psychology and Psychiatry, 53*(12), 1212-1219.

Hawton, K., Cole, D., O'Grady, J., & Osborn, M. (1982). Motivational aspects of deliberate self-poisoning in adolescents. *The British Journal of Psychiatry, 141*(3), 286-291.

Hawton, K., Fagg, J., Simkin, S., Bale, E., & Bond, A. (2000). Deliberate self-harm in adolescents in Oxford, 1985–1995. *Journal of adolescence, 23*(1), 47-55.

Hawton, K., Harriss, L., Hall, S., Simkin, S., Bale, E., & Bond, A. (2003). Deliberate self-harm in Oxford, 1990–2000: a time of change in patient characteristics. *Psychological medicine, 33*(6), 987-995.

Hawton, K., Harriss, L., & Rodham, K. (2010). How adolescents who cut themselves differ from those who take overdoses. *European child & adolescent psychiatry, 19*(6), 513-523.

Hawton, K., Rodham, K., & Evans, E. (2006). *By their own young hand: Deliberate self-harm and suicidal ideas in adolescents*: Jessica Kingsley Publishers.

Hawton, K., Rodham, K., Evans, E., & Harriss, L. (2009). Adolescents who self harm: a comparison of those who go to hospital and those who do not. *Child and Adolescent*

Mental Health, 14(1), 24-30.

Hawton, K., Rodham, K., Evans, E., & Weatherall, R. (2002). Deliberate self harm in adolescents: self report survey in schools in England. *Bmj, 325*(7374), 1207-1211.

Hawton, K., Saunders, K. E., & O'Connor, R. C. (2012). Self-harm and suicide in adolescents. *The Lancet, 379*(9834), 2373-2382.

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*: Guilford Publications.

Hertenstein, E., Feige, B., Gmeiner, T., Kienzler, C., Spiegelhalder, K., Johann, A., . . . Riemann, D. (2019). Insomnia as a predictor of mental disorders: A systematic review and meta-analysis. *Sleep medicine reviews, 43*, 96-105.

Hewitt, P. L., & Flett, G. L. (1991). Dimensions of perfectionism in unipolar depression. *Journal of abnormal psychology, 100*(1), 98.

Hirotsu, C., Tufik, S., & Andersen, M. L. (2015). Interactions between sleep, stress, and metabolism: From physiological to pathological conditions. *Sleep Science, 8*(3), 143-152.

Hirshkowitz, M., Whiton, K., Albert, S. M., Alessi, C., Bruni, O., DonCarlos, L., . . . Kheirandish-Gozal, L. (2015). National Sleep Foundation's sleep time duration recommendations: methodology and results summary. *Sleep health, 1*(1), 40-43.

Hochard, K. D., Ashcroft, S., Carroll, J., Heym, N., & Townsend, E. (2017). Exploring Thematic Nightmare Content and Associated Self-Harm Risk. *Suicide and Life-Threatening Behavior, 49*(1), 64-75.

Hochard, K. D., Heym, N., & Townsend, E. (2015). The unidirectional relationship of nightmares on self-harmful thoughts and behaviors. *Dreaming, 25*(1), 44.

Holmes, E. A., Ghaderi, A., Harmer, C. J., Ramchandani, P. G., Cuijpers, P., Morrison, A. P., . . . Shafran, R. (2018). The Lancet Psychiatry Commission on psychological treatments research in tomorrow's science. *The Lancet Psychiatry, 5*(3), 237-286.

Husky, M., Olié, E., Guillaume, S., Genty, C., Swendsen, J., & Courtet, P. (2014). Feasibility and validity of ecological momentary assessment in the investigation of suicide risk. *Psychiatry research, 220*(1-2), 564-570.

Husky, M., Swendsen, J., Ionita, A., Jaussent, I., Genty, C., & Courtet, P. (2017). Predictors of daily life suicidal ideation in adults recently discharged after a serious suicide attempt: a pilot study. *Psychiatry research, 256*, 79-84.

Hysing, M., Harvey, A. G., Linton, S. J., Askeland, K. G., & Sivertsen, B. (2016). Sleep and academic performance in later adolescence: results from a large population-based study. *Journal of sleep research, 25*(3), 318-324.

Hysing, M., Pallesen, S., Stormark, K. M., Lundervold, A. J., & Sivertsen, B. (2013). Sleep patterns and insomnia among adolescents: a population-based study. *Journal of sleep research, 22*(5), 549-556.

Hysing, M., Sivertsen, B., Stormark, K. M., & O'Connor, R. C. (2015). Sleep problems and self-harm in adolescence. *The British Journal of Psychiatry, 207*(4), 306-312.

Information Services Division Scotland (2019). Suicide Statistics for Scotland: Update of trends to 2018.   Retrieved from https://www.isdscotland.org/Health-Topics/Public-Health/Publications/2019-06-26/2019-06-26-Suicide-Summary.pdf

Information Services Division Scotland. (2016). Suicide Statistics for Scotland: Update of trends to 2016.   Retrieved from https://www.isdscotland.org/Health-Topics/Public-Health/Publications/2017-08-02/2017-08-02-Suicide-Summary.pdf

Im, Y., Oh, W.-O., & Suk, M. (2017). Risk factors for suicide ideation among adolescents: five-year national data analysis. *Archives of psychiatric nursing, 31*(3), 282-286.

Jacobson, C. M., & Gould, M. (2007). The epidemiology and phenomenology of non-suicidal self-injurious behavior among adolescents: A critical review of the literature. *Archives of suicide research, 11*(2), 129-147.

Jang, S.I., Lee, K.S., & Park, E.C. (2013). Relationship between current sleep duration and past suicidal ideation or attempt among Korean adolescents. *Journal of Preventive Medicine and Public Health, 46*(6), 329.

Jenni, O. G., Achermann, P., & Carskadon, M. A. (2005). Homeostatic sleep regulation in

adolescents. *Sleep, 28*(11), 1446-1454.

Jia, C.X., Li, S.B., Han, M., & Bo, Q.G. (2016). Health-related factors and suicidal ideation in high school students in rural China. *OMEGA-Journal of death and dying, 73*(3), 263-274.

Jiang, X., Hardy, L. L., Baur, L. A., Ding, D., Wang, L., & Shi, H. (2015). Sleep duration, schedule and quality among urban Chinese children and adolescents: associations with routine after-school activities. *PLoS One, 10*(1), e0115326.

Jobes, D. A., & Joiner, T. E. (2019). Reflections on suicidal ideation.

Johns, M. W. (1991). A new method for measuring daytime sleepiness: the Epworth sleepiness scale. *Sleep, 14*(6), 540-545.

Johnson, E. O., Roth, T., Schultz, L., & Breslau, N. (2006). Epidemiology of DSM-IV insomnia in adolescence: lifetime prevalence, chronicity, and an emergent gender difference. *Pediatrics, 117*(2), e247-e256.

Joiner, T. (2005). *Why people die by suicide*: Harvard University Press.

Kalak, N., Lemola, S., Brand, S., Holsboer–Trachsler, E., & Grob, A. (2014). Sleep duration and subjective psychological well-being in adolescence: a longitudinal study in Switzerland and Norway. *Neuropsychiatric disease and treatment, 10*, 1199.

Kang, S.-G., Lee, Y. J., Kim, S. J., Lim, W., Lee, H.-J., Park, Y.-M., . . . Hong, J. P. (2014). Weekend catch-up sleep is independently associated with suicide attempts and self-injury in Korean adolescents. *Comprehensive psychiatry, 55*(2), 319-325.

Kaplan, S. G., Ali, S. K., Simpson, B., Britt, V., & McCall, W. V. (2014). Associations between sleep disturbance and suicidal ideation in adolescents admitted to an inpatient psychiatric unit. *International journal of adolescent medicine and health, 26*(3), 411-416.

Kapur, N., Cooper, J., O'Connor, R. C., & Hawton, K. (2013). Non-suicidal self-injury v. attempted suicide: new diagnosis or false dichotomy? *The British Journal of Psychiatry, 202*(5), 326-328.

Kaufman, J., Birmaher, B., Brent, D., Rao, U., Flynn, C., Moreci, P., . . . Ryan, N. (1997). Schedule for affective disorders and schizophrenia for school-age children-present and lifetime version (K-SADS-PL): initial reliability and validity data. *Journal of the American Academy of Child & Adolescent Psychiatry, 36*(7), 980-988.

Kaushik, A., Kostaki, E., & Kyriakopoulos, M. (2016). The stigma of mental illness in children and adolescents: a systematic review. *Psychiatry research, 243*, 469-494.

Kearns, J. C., Coppersmith, D. D., Santee, A. C., Insel, C., Pigeon, W. R., & Glenn, C. R. (2018). Sleep problems and suicide risk in youth: A systematic review, developmental framework, and implications for hospital treatment. *General hospital psychiatry*.

Kim, J.H., Park, E.C., Cho, W.H., Park, J.Y., Choi, W.J., & Chang, H.S. (2013). Association between total sleep duration and suicidal ideation among the Korean general adult population. *Sleep, 36*(10), 1563-1572.

Kim, J.H., Park, E.C., Lee, S. G., & Yoo, K.B. (2015). Associations between time in bed and suicidal thoughts, plans and attempts in Korean adolescents. *BMJ open, 5*(9), e008766.

Kim, Y., Kim, K., Kwon, H.J., & Kim, J.S. (2016). Associations between adolescents' sleep duration, sleep satisfaction, and suicidal ideation. *Salud Mental, 39*(4), 213-219.

Kleiman, E. (2017). Understanding and analyzing multilevel data from real-time monitoring studies: An easily-accessible tutorial using R.

Kleiman, E. M., & Anestis, M. D. (2015). Introduction to the special issue: Recent advances in suicide research: Mediators and moderators of risk and resilience. *International Journal of Cognitive Therapy, 8*(2), 95-98.

Kleiman, E. M., Glenn, C. R., & Liu, R. T. (2019). Real-time monitoring of suicide risk among adolescents: potential barriers, possible solutions, and future directions. *Journal of Clinical Child & Adolescent Psychology, 48*(6), 934-946.

Kleiman, E. M., & Nock, M. K. (2018). Real-time assessment of suicidal thoughts and behaviors. *Current opinion in psychology, 22*, 33-37.

Kline, R. B. (2015). *Principles and practice of structural equation modeling*: Guilford publications.

Klonsky, E. (2011). Non-suicidal self-injury in United States adults: prevalence, sociodemographics, topography and functions. *Psychological medicine, 41*(9), 1981-1986.

Klonsky, E. D. (2007). The functions of deliberate self-injury: A review of the evidence. *Clinical psychology review, 27*(2), 226-239.

Klonsky, E. D., & Glenn, C. R. (2009). Assessing the functions of non-suicidal self-injury: Psychometric properties of the Inventory of Statements About Self-injury (ISAS). *Journal of Psychopathology and Behavioral Assessment, 31*(3), 215-219.

Klonsky, E. D., & May, A. M. (2014). Differentiating suicide attempters from suicide ideators: A critical frontier for suicidology research. *Suicide and Life-Threatening Behavior, 44*(1), 1-5.

Klonsky, E. D., & Muehlenkamp, J. J. (2007). Self-injury: A research review for the practitioner. *Journal of clinical psychology, 63*(11), 1045-1056.

Klonsky, E. D., Saffer, B. Y., & Bryan, C. J. (2018). Ideation-to-action theories of suicide: a conceptual and empirical update. *Current opinion in psychology, 22*, 38-43.

Kokkevi, A., Rotsika, V., Arapaki, A., & Richardson, C. (2012). Adolescents' self-reported suicide attempts, self-harm thoughts and their correlates across 17 European countries. *Journal of Child Psychology and Psychiatry, 53*(4), 381-389.

Koren, D., & Taveras, E. M. (2018). Association of sleep disturbances with obesity, insulin resistance and the metabolic syndrome. *Metabolism, 84*, 67-75.

Kovachy, B., O'Hara, R., Hawkins, N., Gershon, A., Primeau, M. M., Madej, J., & Carrion, V. (2013). Sleep disturbance in pediatric PTSD: current findings and future directions. *Journal of Clinical Sleep Medicine, 9*(05), 501-510.

Koyawala, N., Stevens, J., McBee-Strayer, S. M., Cannon, E. A., & Bridge, J. A. (2015). Sleep problems and suicide attempts among adolescents: a case-control study. *Behavioral sleep medicine, 13*(4), 285-295.

Krakow, B. (2006). Nightmare complaints in treatment-seeking patients in clinical sleep medicine settings: diagnostic and treatment implications. *Sleep, 29*(10), 1313-1319.

Krakow, B. J., Melendrez, D. C., Johnston, L. G., Clark, J. O., Santana, E. M., Warner, T. D., . . . Lee, S. A. (2002). Sleep dynamic therapy for Cerro Grande Fire evacuees with posttraumatic stress symptoms: A preliminary report. *The Journal of clinical psychiatry*.

Kyle, S., & Henry, A. L. (2017). Sleep is a modifiable determinant of health: Implications and opportunities for health psychology. *British journal of health psychology, 22*(4).

Kyle, S. D., Crawford, M. R., Morgan, K., Spiegelhalder, K., Clark, A. A., & Espie, C. A. (2013). The Glasgow Sleep Impact Index (GSII): a novel patient-centred measure for assessing sleep-related quality of life impairment in insomnia disorder. *Sleep medicine, 14*(6), 493-501.

Kyle, S. D., Espie, C. A., & Morgan, K. (2010). "… Not just a minor thing, it is something major, which stops you from functioning daily": quality of life and daytime functioning in insomnia. *Behavioral sleep medicine, 8*(3), 123-140.

Larson, R., & Csikszentmihalyi, M. (1983). The Experience Sampling Method. *New Directions for Methodology of Social & Behavioral Science, 15*, 41-56.

Laye-Gindhu, A., & Schonert-Reichl, K. A. (2005). Nonsuicidal self-harm among community adolescents: Understanding the "whats" and "whys" of self-harm. *Journal of Youth and Adolescence, 34*(5), 447-457.

LeBourgeois, M. K., Giannotti, F., Cortesi, F., Wolfson, A. R., & Harsh, J. (2005). The relationship between reported sleep quality and sleep hygiene in Italian and American adolescents. *Pediatrics, 115*(Supplement 1), 257-265.

Lee, Y. J., Cho, S.J., Cho, I. H., & Kim, S. J. (2012). Insufficient sleep and suicidality in adolescents. *Sleep, 35*(4), 455-460.

Levin, R., & Nielsen, T. A. (2007). Disturbed dreaming, posttraumatic stress disorder, and affect distress: A review and neurocognitive model. *Psychological bulletin, 133*(3),

482.

Li, S., Yaseen, Z. S., Kim, H.J., Briggs, J., Duffy, M., Frechette-Hagan, A., . . . Galynker, I. I. (2018). Entrapment as a mediator of suicide crises. *BMC psychiatry, 18*(1), 4.

Littlewood, D., Kyle, S., Pratt, D., Peters, S., & Gooding, P. (2017). Examining the role of psychological factors in the relationship between sleep problems and suicide. *Clinical psychology review, 54*, 1-16.

Littlewood, D. L., Gooding, P., Kyle, S. D., Pratt, D., & Peters, S. (2016). Understanding the role of sleep in suicide risk: qualitative interview study. *BMJ open, 6*(8), e012113.

Littlewood, D. L., Gooding, P. A., Panagioti, M., & Kyle, S. D. (2016). Nightmares and suicide in posttraumatic stress disorder: the mediating role of defeat, entrapment, and hopelessness. *Journal of Clinical Sleep Medicine, 12*(03), 393-399.

Littlewood, D. L., Kyle, S. D., Carter, L.-A., Peters, S., Pratt, D., & Gooding, P. (2019). Short sleep duration and poor sleep quality predict next-day suicidal ideation: an ecological momentary assessment study. *Psychological medicine, 49*(3), 403-411.

Liu, J.W., Tu, Y.K., Lai, Y.F., Lee, H.C., Tsai, P.S., Chen, T.J., . . . Chiu, H.Y. (2019). Associations between sleep disturbances and suicidal ideation, plans, and attempts in adolescents: a systematic review and meta-analysis. *Sleep, 42*(6), zsz054.

Liu, X. (2004). Sleep and adolescent suicidal behavior. *Sleep, 27*(7), 1351-1358.

Liu, X., & Buysse, D. J. (2006). Sleep and youth suicidal behavior: a neglected field. *Current opinion in psychiatry, 19*(3), 288-293.

Liu, X., Chen, H., Bo, Q.G., Fan, F., & Jia, C.X. (2017). Poor sleep quality and nightmares are associated with non-suicidal self-injury in adolescents. *European child & adolescent psychiatry, 26*(3), 271-279.

Liu, X., Liu, Z.Z., Wang, Z.Y., Yang, Y., Liu, B.P., & Jia, C.X. (2018). Daytime sleepiness predicts future suicidal behavior: a longitudinal study of adolescents. *Sleep, 42*(2), zsy225.

Lo, J. C., Ong, J. L., Leong, R. L., Gooley, J. J., & Chee, M. W. (2016). Cognitive performance, sleepiness, and mood in partially sleep deprived adolescents: the need for sleep study. *Sleep, 39*(3), 687-698.

Lockwood, J., Daley, D., Townsend, E., & Sayal, K. (2017). Impulsivity and self-harm in adolescence: a systematic review. *European child & adolescent psychiatry, 26*(4), 387-402.

Loessl, B., Valerius, G., Kopasz, M., Hornyak, M., Riemann, D., & Voderholzer, U. (2008). Are adolescents chronically sleep-deprived? An investigation of sleep habits of adolescents in the Southwest of Germany. *Child: care, health and development, 34*(5), 549-556.

Lovato, N., & Gradisar, M. (2014). A meta-analysis and model of the relationship between sleep and depression in adolescents: recommendations for future research and clinical practice. *Sleep medicine reviews, 18*(6), 521-529.

Lovato, N., Gradisar, M., Short, M., Dohnt, H., & Micic, G. (2013). Delayed sleep phase disorder in an Australian school-based sample of adolescents. *Journal of Clinical Sleep Medicine, 9*(09), 939-944.

Lundh, L.G., Bjärehed, J., & Wångby-Lundh, M. (2013). Poor sleep as a risk factor for nonsuicidal self-injury in adolescent girls. *Journal of Psychopathology and Behavioral Assessment, 35*(1), 85-92.

Luo, C., Zhang, J., & Pan, J. (2013). One-year course and effects of insomnia in rural Chinese adolescents. *Sleep, 36*(3), 377-384.

Madge, N., Hewitt, A., Hawton, K., Wilde, E. J. d., Corcoran, P., Fekete, S., . . . Ystgaard, M. (2008). Deliberate self-harm within an international community sample of young people: comparative findings from the Child & Adolescent Self-harm in Europe (CASE) Study. *Journal of Child Psychology and Psychiatry, 49*(6), 667-677.

Mann, J. J., McBride, P. A., Brown, R. P., Linnoilam, M., Leon, A. C., DeMeo, M., . . . Stanley, M. (1992). Relationship between central and peripheral serotonin indexes in depressed and suicidal psychiatric inpatients. *Archives of general psychiatry, 49*(6), 442-446.

Mars, B., Cornish, R., Heron, J., Boyd, A., Crane, C., Hawton, K., . . . Gunnell, D. (2016). Using data linkage to investigate inconsistent reporting of self-harm and questionnaire non-response. *Archives of suicide research, 20*(2), 113-141.

Mars, B., Heron, J., Crane, C., Hawton, K., Lewis, G., Macleod, J., . . . Gunnell, D. (2014). Clinical and social outcomes of adolescent self harm: population based birth cohort study. *Bmj, 349*, g5954.

Mars, B., Heron, J., Klonsky, E. D., Moran, P., O'Connor, R. C., Tilling, K., . . . Gunnell, D. (2019). Predictors of future suicide attempt among adolescents with suicidal thoughts or non-suicidal self-harm: a population-based birth cohort study. *The Lancet Psychiatry, 6*(4), 327-337.

Mars, B., Heron, J., Klonsky, E. D., Moran, P., O'Connor, R. C., Tilling, K., . . . Gunnell, D. (2019). What distinguishes adolescents with suicidal thoughts from those who have attempted suicide? A population-based birth cohort study. *Journal of Child Psychology and Psychiatry, 60*(1), 91-99.

Matamura, M., Tochigi, M., Usami, S., Yonehara, H., Fukushima, M., Nishida, A., . . . Sasaki, T. (2014). Associations between sleep habits and mental health status and suicidality in a longitudinal survey of monozygotic twin adolescents. *Journal of sleep research, 23*(3), 292-296.

McCall, W. V., Batson, N., Webster, M., Case, L. D., Joshi, I., Derreberry, T., . . . Farris, S. R. (2013). Nightmares and dysfunctional beliefs about sleep mediate the effect of insomnia symptoms on suicidal ideation. *Journal of Clinical Sleep Medicine, 9*(02), 135-140.

McCall, W. V., & Black, C. G. (2013). The link between suicide and insomnia: theoretical mechanisms. *Current psychiatry reports, 15*(9), 389.

McCann, T. V., Clark, E., McConnachie, S., & Harvey, I. (2007). Deliberate self-harm: emergency department nurses' attitudes, triage and care intentions. *Journal of clinical nursing, 16*(9), 1704-1711.

McGlinchey, E. L., Courtney-Seidler, E. A., German, M., & Miller, A. L. (2017). The role of sleep disturbance in suicidal and nonsuicidal self-injurious behavior among adolescents. *Suicide and Life-Threatening Behavior, 47*(1), 103-111.

McKnight-Eily, L. R., Eaton, D. K., Lowry, R., Croft, J. B., Presley-Cantrell, L., & Perry, G. S. (2011). Relationships between hours of sleep and health-risk behaviors in US adolescent students. *Preventive medicine, 53*(4-5), 271-273.

McMahon, E. M., Keeley, H., Cannon, M., Arensman, E., Perry, I. J., Clarke, M., . . . Corcoran, P. (2014). The iceberg of suicide and self-harm in Irish adolescents: a population-based study. *Social psychiatry and psychiatric epidemiology, 49*(12), 1929-1935.

McMakin, D. L., & Alfano, C. A. (2015). Sleep and anxiety in late childhood and early adolescence. *Current opinion in psychiatry, 28*(6), 483.

McManus, S., Bebbington, P., Jenkins, R., & Brugha, T. (2016). *Mental Health and Wellbeing in England: Adult Psychiatric Morbidity Survey 2014: a Survey Carried Out for NHS Digital by NatCen Social Research and the Department of Health Sciences, University of Leicester*: NHS Digital.

McManus, S., Gunnell, D., Cooper, C., Bebbington, P. E., Howard, L. M., Brugha, T., . . . Appleby, L. (2019). Prevalence of non-suicidal self-harm and service contact in England, 2000–14: repeated cross-sectional surveys of the general population. *The Lancet Psychiatry*.

Meerlo, P., Sgoifo, A., & Suchecki, D. (2008). Restricted and disrupted sleep: effects on autonomic function, neuroendocrine stress systems and stress responsivity. *Sleep medicine reviews, 12*(3), 197-210.

Merikangas, K. R., Avenevoli, S., Costello, E. J., Koretz, D., & Kessler, R. C. (2009). National comorbidity survey replication adolescent supplement (NCS-A): I. Background and measures. *Journal of the American Academy of Child & Adolescent Psychiatry, 48*(4), 367-379.

Millner, A. J., Lee, M. D., & Nock, M. K. (2015). Single-item measurement of suicidal

behaviors: Validity and consequences of misclassification. *PLoS One, 10*(10), e0141606.

Mills, K. L., Goddings, A.-L., Herting, M. M., Meuwese, R., Blakemore, S.-J., Crone, E. A., . . . Sowell, E. R. (2016). Structural brain development between childhood and adulthood: convergence across four longitudinal samples. *Neuroimage, 141*, 273-281.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of internal medicine, 151*(4), 264-269.

Moore, R. Y., & Eichler, V. B. (1972). Loss of a circadian adrenal corticosterone rhythm following suprachiasmatic lesions in the rat. *Brain research*.

Moran, P. (2015). Adolescents who self-harm are at increased risk of health and social problems as young adults. *Evidence-based mental health, 18*(2), 52-52.

Moran, P., Coffey, C., Romaniuk, H., Olsson, C., Borschmann, R., Carlin, J. B., & Patton, G. C. (2012). The natural history of self-harm from adolescence to young adulthood: a population-based cohort study. *The Lancet, 379*(9812), 236-243.

Morin, C. M., Belleville, G., Bélanger, L., & Ivers, H. (2011). The Insomnia Severity Index: psychometric indicators to detect insomnia cases and evaluate treatment response. *Sleep, 34*(5), 601-608.

Morin, C. M., Drake, C. L., Harvey, A. G., Krystal, A. D., Manber, R., Riemann, D., & Spiegelhalder, K. (2015). Insomnia disorder. *Nature Reviews Disease Primers, 1*, 15026.

Morin, C. M., Vallières, A., & Ivers, H. (2007). Dysfunctional beliefs and attitudes about sleep (DBAS): validation of a brief version (DBAS-16). *Sleep, 30*(11), 1547-1554.

Myin-Germeys, I., Klippel, A., Steinhart, H., & Reininghaus, U. (2016). Ecological momentary interventions in psychiatry. *Current opinion in psychiatry, 29*(4), 258-263.

Myin-Germeys, I., Oorschot, M., Collip, D., Lataster, J., Delespaul, P., & Van Os, J. (2009). Experience sampling research in psychopathology: opening the black box of daily life. *Psychological medicine, 39*(9), 1533-1547.

Nadorff, M. R., Anestis, M. D., Nazem, S., Harris, H. C., & Winer, E. S. (2014). Sleep disorders and the interpersonal–psychological theory of suicide: Independent pathways to suicidality? *Journal of affective disorders, 152*, 505-512.

Nadorff, M. R., Nazem, S., & Fiske, A. (2013). Insomnia symptoms, nightmares, and suicide risk: duration of sleep disturbance matters. *Suicide and Life-Threatening Behavior, 43*(2), 139-149.

National Office for Statistics. (2019). Suicides in the UK: 2018 registrations.   Retrieved from https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/suicidesintheunitedkingdom/2018registrations#suicides-in-the-uk

Nielsen, E., Sayal, K., & Townsend, E. (2017). Dealing with difficult days: Functional coping dynamics in self-harm ideation and enactment. *Journal of affective disorders, 208*, 330-337.

Nielsen, T., & Levin, R. (2007). Nightmares: a new neurocognitive model. *Sleep medicine reviews, 11*(4), 295-310.

Nielsen, T. A., Laberge, L., Paquet, J., Tremblay, R. E., Vitaro, F., & Montplaisir, J. (2000). Development of disturbing dreams during adolescence and their relation to anxiety symptoms. *Sleep, 23*(6), 1-10.

Nock, M. K. (2010). Self-injury. *Annual review of clinical psychology, 6*, 339-363.

Nock, M. K. (2012). Future directions for the study of suicide and self-injury. *Journal of Clinical Child & Adolescent Psychology, 41*(2), 255-259.

Nock, M. K., & Prinstein, M. J. (2004). A functional approach to the assessment of self-mutilative behavior. *Journal of consulting and clinical psychology, 72*(5), 885.

Nock, M. K. (2009a). Why do people hurt themselves? New insights into the nature and functions of self-injury. Current directions in psychological science, 18(2), 78-83.

Nock, M. K., Prinstein, M. J., & Sterba, S. K. (2009b). Revealing the form and function of self-injurious thoughts and behaviors: A real-time ecological assessment study

among adolescents and young adults. *Journal of abnormal psychology, 118*(4), 816.

Nrugham, L., Larsson, B., & Sund, A. M. (2008). Specific depressive symptoms and disorders as associates and predictors of suicidal acts across adolescence. *Journal of affective disorders, 111*(1), 83-93.

O'Brien, E. M., & Mindell, J. A. (2005). Sleep and risk-taking behavior in adolescents. *Behavioral sleep medicine, 3*(3), 113-133.

O'Connor, R. C. (2011). The integrated motivational-volitional model of suicidal behavior: Hogrefe Publishing.

O'Connor, R. C. (2011). Towards an integrated motivational–volitional model of suicidal behaviour. *International handbook of suicide prevention: Research, policy and practice, 1*, 181-198.

O'Connor, R. C., & Portzky, G. (2018). Looking to the future: a synthesis of new developments and challenges in suicide research and prevention. *Frontiers in psychology, 9*.

O'Connor, R. C., & Portzky, G. (2018). The relationship between entrapment and suicidal behavior through the lens of the integrated motivational–volitional model of suicidal behavior. *Current opinion in psychology, 22*, 12-17.

O'Connor, R. C., Whyte, M.-C., Fraser, L., Masterton, G., Miles, J., & MacHale, S. (2007). Predicting short-term outcome in well-being following suicidal behaviour: The conjoint effects of social perfectionism and positive future thinking. *Behaviour research and therapy, 45*(7), 1543-1555.

O'Connor, R. C. (2003). Suicidal behavior as a cry of pain: Test of a psychological model. *Archives of suicide research, 7*(4), 297-308.

O'Connor, R., Rasmussen, S., & Hawton, K. (2014). Adolescent self-harm: a school-based study in Northern Ireland. *Journal of affective disorders, 159*, 46-52.

O'Connor, R. C., Cleare, S., Eschle, S., Wetherall, K., & Kirtley, O. J. (2016). The Integrated Motivational-Volitional Model of Suicidal Behavior: An Update. *The International Handbook of Suicide Prevention*, 220-240.

O'Connor, R. C., Ferguson, E., Scott, F., Smyth, R., McDaid, D., Park, A.-L., . . . Armitage, C. J. (2017). A brief psychological intervention to reduce repetition of self-harm in patients admitted to hospital following a suicide attempt: a randomised controlled trial. *The Lancet Psychiatry, 4*(6), 451-460.

O'Connor, R. C., & Kirtley, O. J. (2018). The integrated motivational–volitional model of suicidal behaviour. *Philosophical Transactions of the Royal Society B: Biological Sciences, 373*(1754), 20170268.

O'Connor, R. C., & Nock, M. K. (2014). The psychology of suicidal behaviour. *The Lancet Psychiatry, 1*(1), 73-85.

O'Connor, R. C., Rasmussen, S., & Hawton, K. (2010). Predicting depression, anxiety and self-harm in adolescents: The role of perfectionism and acute life stress. *Behaviour research and therapy, 48*(1), 52-59.

O'Connor, R. C., Rasmussen, S., & Hawton, K. (2012). Distinguishing adolescents who think about self-harm from those who engage in self-harm. *The British Journal of Psychiatry, 200*(4), 330-335.

O'Connor, R. C., Rasmussen, S., Miles, J., & Hawton, K. (2009). Self-harm in adolescents: self-report survey in schools in Scotland. *The British Journal of Psychiatry, 194*(1), 68-72.

O'Connor, R. C., Wetherall, K., Cleare, S., Eschle, S., Drummond, J., Ferguson, E., . . . O'Carroll, R. E. (2018). Suicide attempts and non-suicidal self-harm: national prevalence study of young adults. *BJPsych open, 4*(3), 142-148.

Ohayon, M. M., Carskadon, M. A., Guilleminault, C., & Vitiello, M. V. (2004). Meta-analysis of quantitative sleep parameters from childhood to old age in healthy individuals: developing normative sleep values across the human lifespan. *Sleep, 27*(7), 1255-1273.

Ohayon, M. M., Chen, M. C., Bixler, E., Dauvilliers, Y., Gozal, D., Plazzi, G., . . . Hirshkowitz, M. (2018). A provisional tool for the measurement of sleep satisfaction. *Sleep health,*

4(1), 6-12.

Ohayon, M. M., Roberts, R. E., Zulley, J., Smirne, S., & Priest, R. G. (2000). Prevalence and patterns of problematic sleep among older adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry, 39*(12), 1549-1556.

Oka, Y., Horiuchi, F., Tanigawa, T., Kawabe, K., Okada, F., & Ueno, S. (2009). Development of a new sleep screening questionnaire: Child and Adolescent Sleep Checklist (CASC). *Jpn J Sleep Med, 3*(2), 404-408.

Olds, T., Blunden, S., Petkov, J., & Forchino, F. (2010). The relationships between sex, age, geography and time in bed in adolescents: a meta-analysis of data from 23 countries. *Sleep medicine reviews, 14*(6), 371-378.

Olfson, M., Wall, M., Wang, S., Crystal, S., Bridge, J. A., Liu, S.-M., & Blanco, C. (2018). Suicide after deliberate self-harm in adolescents and young adults. *Pediatrics, 141*(4), e20173517.

World Health Organization. (2014). *Health for the world's adolescents: a second chance in the second decade: summary*. Geneva, Switzerland.

World Health Organization. (2018). Global Health Estimates 2016: Deaths by cause, age, sex, by country and by region, 2000-2016. World Health Organization, Geneva.

World Health Organization. (2019). Suicide Key Facts 2019.   Retrieved from https://www.who.int/news-room/fact-sheets/detail/suicide

Orlando, C. M., Broman-Fulks, J. J., Whitlock, J. L., Curtin, L., & Michael, K. D. (2015). Nonsuicidal self-injury and suicidal self-injury: A taxometric investigation. *Behavior therapy, 46*(6), 824-833.

Owen, R., Dempsey, R., Jones, S., & Gooding, P. (2018). Defeat and entrapment in bipolar disorder: exploring the relationship with suicidal ideation from a psychological theoretical perspective. *Suicide and Life-Threatening Behavior, 48*(1), 116-128.

Owens, D., Horrocks, J., & House, A. (2002). Fatal and non-fatal repetition of self-harm: systematic review. *The British Journal of Psychiatry, 181*(3), 193-199.

Owens, D., Kelley, R., Munyombwe, T., Bergen, H., Hawton, K., Cooper, J., . . . Kapur, N. (2015). Switching methods of self-harm at repeat episodes: findings from a multicentre cohort study. *Journal of affective disorders, 180*, 44-51.

Owens, J., & Group, A. S. W. (2014). Insufficient sleep in adolescents and young adults: an update on causes and consequences. *Pediatrics, 134*(3), e921-e932.

Paksarian, D., Rudolph, K. E., He, J.P., & Merikangas, K. R. (2015). School start time and adolescent sleep patterns: results from the US national comorbidity survey—adolescent supplement. *American journal of public health, 105*(7), 1351-1357.

Palmer, C. A., Oosterhoff, B., Bower, J. L., Kaplow, J. B., & Alfano, C. A. (2018). Associations among adolescent sleep problems, emotion regulation, and affective disorders: Findings from a nationally representative sample. *Journal of psychiatric research, 96*, 1-8.

Palmier-Claus, J., Haddock, G., & Varese, F. (2019). *Experience sampling in mental health research*: Routledge.

Park, J. H., Yoo, J. H., & Kim, S. H. (2013). Associations between non-restorative sleep, short sleep duration and suicidality: Findings from a representative sample of K orean adolescents. *Psychiatry and clinical neurosciences, 67*(1), 28-34.

Park, T.J., & Kim, J. (2017). Is insufficient sleep duration associated with suicidal behavior in Korean adolescents? *Sleep and Biological Rhythms, 15*(2), 117-125.

Park, W.S., Yang, K. I., & Kim, H. (2019). Insufficient sleep and suicidal ideation: a survey of 12,046 female adolescents. *Sleep medicine, 53*, 65-69.

Park, Y.J., Ryu, H., Han, K., Kwon, J. H., Kim, H. K., Kang, H. C., . . . Shin, H. (2010). Suicidal ideation in adolescents: an explanatory model using LISREL. *Western Journal of Nursing Research, 32*(2), 168-184.

Paruthi, S., Brooks, L. J., D'Ambrosio, C., Hall, W. A., Kotagal, S., Lloyd, R. M., . . . Quan, S. F. (2016). Recommended amount of sleep for pediatric populations: a consensus statement of the American Academy of Sleep Medicine. *Journal of Clinical Sleep Medicine, 12*(06), 785-786.

Pasch, K. E., Laska, M. N., Lytle, L. A., & Moe, S. G. (2010). Adolescent sleep, risk behaviors, and depressive symptoms: are they linked? *American journal of health behavior, 34*(2), 237-248.

Paykel, E., Myers, J., Lindenthal, J., & Tanner, J. (1974). Suicidal feelings in the general population: a prevalence study. *The British Journal of Psychiatry, 124*(582), 460-469.

Perry, I. J., Corcoran, P., Fitzgerald, A. P., Keeley, H. S., Reulbach, U., & Arensman, E. (2012). The incidence and repetition of hospital-treated deliberate self harm: findings from the world's first national registry. *PLoS One, 7*(2), e31663.

Pigeon, W. R., Pinquart, M., & Conner, K. (2012). Meta-analysis of sleep disturbance and suicidal thoughts and behaviors. *The Journal of clinical psychiatry.*

Pitman, A., Osborn, D., King, M., & Erlangsen, A. (2014). Effects of suicide bereavement on mental health and suicide risk. *The Lancet Psychiatry, 1*(1), 86-94.

Plener, P. L., Schumacher, T. S., Munz, L. M., & Groschwitz, R. C. (2015). The longitudinal course of non-suicidal self-injury and deliberate self-harm: a systematic review of the literature. *Borderline personality disorder and emotion dysregulation, 2*(1), 2.

Quigley, J., Rasmussen, S., & McAlaney, J. (2017). The social norms of suicidal and self-harming behaviours in Scottish adolescents. *International journal of environmental research and public health, 14*(3), 307.

Ramlee, F., Sanborn, A. N., & Tang, N. K. (2017). What sways people's judgment of sleep quality? a quantitative choice-making study with good and poor sleepers. *Sleep, 40*(7), zsx091.

Rasmussen, S., Hawton, K., Philpott-Morgan, S., & O'Connor, R. C. (2016). Why do adolescents self-harm? *Crisis.*

Rasmussen, S. A., Fraser, L., Gotz, M., MacHale, S., Mackie, R., Masterton, G., . . . O'Connor, R. C. (2010). Elaborating the cry of pain model of suicidality: Testing a psychological model in a sample of first-time and repeat self-harm patients. *British Journal of Clinical Psychology, 49*(1), 15-30.

Reid, A., Maldonado, C. C., & Baker, F. C. (2002). Sleep behavior of South African adolescents. *Sleep, 25*(4), 417-421.

Reynolds, W. M. (1987). Suicidal ideation questionnaire (SIQ). *Odessa, FL: Psychological Assessment Resources.*

Reynolds, W. M. (1990). Development of a semistructured clinical interview for suicidal behaviors in adolescents. *Psychological Assessment: A Journal of Consulting and Clinical Psychology, 2*(4), 382.

Rigney, G., Blunden, S., Maher, C., Dollman, J., Parvazian, S., Matricciani, L., & Olds, T. (2015). Can a school-based sleep education programme improve sleep knowledge, hygiene and behaviours using a randomised controlled trial. *Sleep medicine, 16*(6), 736-745.

Rihmer, Z., Dome, P., O'Connor, R., & Pirkis, J. (2016). Major mood disorders and suicidal behavior. *The International Handbook of Suicide Prevention*, 74-92.

Roane, B. M., & Taylor, D. J. (2008). Adolescent insomnia as a risk factor for early adult depression and substance abuse. *Sleep, 31*(10), 1351-1356.

Roberts, R. E., & Duong, H. T. (2014). The prospective association between sleep deprivation and depression among adolescents. *Sleep, 37*(2), 239-244.

Roberts, R. E., Roberts, C. R., & Chen, I. G. (2001). Functioning of adolescents with symptoms of disturbed sleep. *Journal of Youth and Adolescence, 30*(1), 1-18.

Roberts, R. E., Roberts, C. R., & Chen, Y. R. (1997). Ethnocultural differences in prevalence of adolescent depression. *American journal of community psychology, 25*(1), 95-110.

Roberts, R. E., Roberts, C. R., & Duong, H. T. (2008). Chronic insomnia and its negative consequences for health and functioning of adolescents: a 12-month prospective study. *Journal of Adolescent Health, 42*(3), 294-302.

Rodham, K., Hawton, K., & Evans, E. (2004). Reasons for deliberate self-harm: comparison of self-poisoners and self-cutters in a community sample of adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry, 43*(1), 80-87.

Rodríguez-Blanco, L., Carballo, J. J., & Baca-García, E. (2018). Use of ecological

momentary assessment (EMA) in non-suicidal self-injury (NSSI): A systematic review. *Psychiatry research, 263*, 212-219.

Rodway, C., Tham, S.-G., Ibrahim, S., Turnbull, P., Windfuhr, K., Shaw, J., . . . Appleby, L. (2016). Suicide in children and young people in England: a consecutive case series. *The Lancet Psychiatry, 3*(8), 751-759.

Roenneberg, T., Keller, L. K., Fischer, D., Matera, J. L., Vetter, C., & Winnebeck, E. C. (2015). Human activity and rest in situ *Methods in enzymology* (Vol. 552, pp. 257-283): Elsevier.

Roenneberg, T., Kuehnle, T., Juda, M., Kantermann, T., Allebrandt, K., Gordijn, M., & Merrow, M. (2007). Epidemiology of the human circadian clock. *Sleep medicine reviews, 11*(6), 429-438.

Roenneberg, T., Kuehnle, T., Pramstaller, P. P., Ricken, J., Havel, M., Guth, A., & Merrow, M. (2004). A marker for the end of adolescence. *Current biology, 14*(24), R1038-R1039.

Roenneberg, T., Wirz-Justice, A., & Merrow, M. (2003). Life between clocks: daily temporal patterns of human chronotypes. *Journal of biological rhythms, 18*(1), 80-90.

Rogers, M. L., Galynker, I., Yaseen, Z., DeFazio, K., & Joiner, T. E. (2017). An overview and comparison of two proposed suicide-specific diagnoses: Acute suicidal affective disturbance and suicide crisis syndrome. *Psychiatric Annals, 47*(8), 416-420.

Russell, K., Allan, S., Beattie, L., Bohan, J., MacMahon, K., & Rasmussen, S. (2019). Sleep problem, suicide and self-harm in university students: A systematic review. *Sleep medicine reviews*.

Russell, K., Rasmussen, S., & Hunter, S. C. (2018). Insomnia and nightmares as markers of risk for suicidal ideation in young people: investigating the role of defeat and entrapment. *Journal of Clinical Sleep Medicine, 14*(05), 775-784.

Saarenpää-Heikkilä, O., Rintahaka, P. J., Laippala, P. J., & Koivikko, M. J. (1995). Sleep habits and disorders in Finnish schoolchildren. *Journal of sleep research, 4*(3), 173-182.

Sami, H., Danielle, L., Lihi, D., & Elena, S. (2018). The effect of sleep disturbances and internet addiction on suicidal ideation among adolescents in the presence of depressive symptoms. *Psychiatry research, 267*, 327-332.

Sarchiapone, M., Mandelli, L., Carli, V., Iosue, M., Wasserman, C., Hadlaczky, G., . . . Bobes, J. (2014). Hours of sleep in adolescents and its association with anxiety, emotional concerns, and suicidal ideation. *Sleep medicine, 15*(2), 248-254.

Schmitt, T. A. (2011). Current methodological considerations in exploratory and confirmatory factor analysis. *Journal of Psychoeducational Assessment, 29*(4), 304-321.

Schuck, A., Calati, R., Barzilay, S., Bloch-Elkouby, S., & Galynker, I. (2019). Suicide Crisis Syndrome: A review of supporting evidence for a new suicide-specific diagnosis. *Behavioral sciences & the law*.

Scoliers, G., Portzky, G., Madge, N., Hewitt, A., Hawton, K., De Wilde, E. J., . . . Fekete, S. (2009). Reasons for adolescent deliberate self-harm: a cry of pain and/or a cry for help? *Social psychiatry and psychiatric epidemiology, 44*(8), 601-607.

Scottish Government (2017). *Mental Health Strategy 2017-2027*. Edinburgh, Scotland.

Scottish Government (2018). *Suicide prevention action plan: every life matters*. Edinburgh, Scotland

Scott, H., Biello, S. M., & Woods, H. (2018). Identifying drivers for bedtime social media use despite sleep costs: the adolescent perspective.

Scott, H., & Woods, H. C. (2018). Fear of missing out and sleep: Cognitive behavioural factors in adolescents' nighttime social media use. *Journal of adolescence, 68*, 61-65.

Scott, H., & Woods, H. C. (2019). Understanding links between social media use, sleep and mental health: recent progress and current challenges. *Current sleep medicine reports, 5*(3), 141-149.

Shan, Z., Ma, H., Xie, M., Yan, P., Guo, Y., Bao, W., . . . Liu, L. (2015). Sleep duration and risk of type 2 diabetes: a meta-analysis of prospective studies. *Diabetes care, 38*(3),

529-537.

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., . . . Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (MINI): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *The Journal of clinical psychiatry*.

Sheehan, D. V., Sheehan, K. H., Shytle, R. D., Janavs, J., Bannon, Y., Rogers, J. E., . . . Wilkinson, B. (2010). Reliability and validity of the mini international neuropsychiatric interview for children and adolescents (MINI-KID). *The Journal of clinical psychiatry*.

Shochat, T., Cohen-Zion, M., & Tzischinsky, O. (2014). Functional consequences of inadequate sleep in adolescents: a systematic review. *Sleep medicine reviews, 18*(1), 75-87.

Short, M. A., Gradisar, M., Gill, J., & Camfferman, D. (2013a). Identifying adolescent sleep problems. *PLoS One, 8*(9), e75301.

Short, M. A., Gradisar, M., Lack, L. C., Wright, H. R., & Dohnt, H. (2013b). The sleep patterns and well-being of Australian adolescents. *Journal of adolescence, 36*(1), 103-110.

Short, M. A., Gradisar, M., Wright, H., Lack, L. C., Dohnt, H., & Carskadon, M. A. (2011). Time for bed: parent-set bedtimes associated with improved sleep and daytime functioning in adolescents. *Sleep, 34*(6), 797-800.

Short, M. A., & Louca, M. (2015). Sleep deprivation leads to mood deficits in healthy adolescents. *Sleep medicine, 16*(8), 987-993.

Short, M. A., Weber, N., Reynolds, C., Coussens, S., & Carskadon, M. A. (2018). Estimating adolescent sleep need using dose-response modeling. *Sleep, 41*(4), zsy011.

Siddaway, A. P., Taylor, P. J., Wood, A. M., & Schulz, J. (2015). A meta-analysis of perceptions of defeat and entrapment in depression, anxiety problems, posttraumatic stress disorder, and suicidality. *Journal of affective disorders, 184*, 149-159.

Silverman, M. M. (2016). Challenges to defining and classifying suicide and suicidal behaviors. *The International Handbook of Suicide Prevention, 11*.

Silverman, M. M., & De Leo, D. (2016). Why there is a need for an international nomenclature and classification system for suicide: Hogrefe Publishing.

Sivertsen, B., Pallesen, S., Stormark, K. M., Bøe, T., Lundervold, A. J., & Hysing, M. (2013). Delayed sleep phase syndrome in adolescents: prevalence and correlates in a large population based study. *BMC public health, 13*(1), 1163.

Somerville, L. H., & Casey, B. (2010). Developmental neurobiology of cognitive control and motivational systems. *Current opinion in neurobiology, 20*(2), 236-241.

Speed, K. J., Drapeau, C. W., & Nadorff, M. R. (2018). Differentiating single and multiple suicide attempters: what nightmares can tell us that other predictors cannot. *Journal of Clinical Sleep Medicine, 14*(05), 829-834.

Spielman, A. J., Caruso, L. S., & Glovinsky, P. B. (1987). A behavioral perspective on insomnia treatment. *Psychiatric Clinics of North America, 10*(4), 541-553.

Stallard, P., Spears, M., Montgomery, A. A., Phillips, R., & Sayal, K. (2013). Self-harm in young adolescents (12–16 years): onset and short-term continuation in a community sample. *BMC psychiatry, 13*(1), 328.

Steinberg, L. (2010). A dual systems model of adolescent risk-taking. *Developmental Psychobiology: The Journal of the International Society for Developmental Psychobiology, 52*(3), 216-224.

Steinberg, L. (2016). *Adolescence* (11th Edition ed.). New York: McGraw Hill Education

Steinberg, L., Icenogle, G., Shulman, E. P., Breiner, K., Chein, J., Bacchini, D., . . . Dodge, K. A. (2018). Around the world, adolescence is a time of heightened sensation seeking and immature self-regulation. *Developmental science, 21*(2), e12532.

Stewart, S. M., Eaddy, M., Horton, S. E., Hughes, J., & Kennard, B. (2017). The validity of the interpersonal theory of suicide in adolescence: A review. *Journal of Clinical Child & Adolescent Psychology, 46*(3), 437-449.

Strandheim, A., Bjerkeset, O., Gunnell, D., Bjørnelv, S., Holmen, T. L., & Bentzen, N. (2014). Risk factors for suicidal thoughts in adolescence-a prospective cohort study: the

Young-HUNT study. *BMJ open, 4*(8), e005867.

Strang, N. M., Chein, J. M., & Steinberg, L. (2013). The value of the dual systems model of adolescent risk-taking. *Frontiers in human neuroscience, 7*, 223.

Talbot, L. S., McGlinchey, E. L., Kaplan, K. A., Dahl, R. E., & Harvey, A. G. (2010). Sleep deprivation in adolescents and adults: changes in affect. *Emotion, 10*(6), 831.

Tarokh, L., Carskadon, M. A., & Achermann, P. (2012). Dissipation of sleep pressure is stable across adolescence. *Neuroscience, 216*, 167-177.

Tarokh, L., Saletin, J. M., & Carskadon, M. A. (2016). Sleep in adolescence: Physiology, cognition and mental health. *Neuroscience and biobehavioral reviews, 70*, 182.

Taylor, P. J., Gooding, P., Wood, A. M., & Tarrier, N. (2011). The role of defeat and entrapment in depression, anxiety, and suicide. *Psychological bulletin, 137*(3), 391.

Telzer, E. H., Fuligni, A. J., Lieberman, M. D., & Galván, A. (2013). The effects of poor quality sleep on brain function and risk taking in adolescence. *Neuroimage, 71*, 275-283.

The National Institute for Health and Care Excellence (NICE), (2011). Self-Harm in over 8s: Long-Term Management. Clinical Guideline [CG133].

The National Institute for Health and Care Excellence (NICE), (2004). Self-Harm in over 8s: Short-Term Management and Prevention of Recurrence. Clinical Guideline [CG16].

Titus, C. E., Speed, K. J., Cartwright, P. M., Drapeau, C. W., Heo, Y., & Nadorff, M. R. (2018). What role do nightmares play in suicide? A brief exploration. *Current opinion in psychology, 22*, 59-62.

Touitou, Y. (2013). Adolescent sleep misalignment: a chronic jet lag and a matter of public health. *Journal of Physiology-Paris, 107*(4), 323-326.

Townsend, E. (2014). Self-harm in young people. *Evidence-based mental health, 17*(4), 97-99.

Townsend, E., Wadman, R., Sayal, K., Armstrong, M., Harroe, C., Majumder, P., . . . Clarke, D. (2016). Uncovering key patterns in self-harm in adolescents: Sequence analysis using the Card Sort Task for Self-harm (CaTS). *Journal of affective disorders, 206*, 161-168.

Trivedi, M. H., Wisniewski, S. R., Morris, D. W., Fava, M., Gollan, J. K., Warden, D., . . . Luther, J. F. (2011). Concise Health Risk Tracking scale: a brief self-report and clinician rating of suicidal risk. *Journal of Clinical Psychiatry, 72*(6), 757.

Tseng, W.-C., Liang, Y.-C., Su, M.-H., Chen, Y.-L., Yang, H.-J., & Kuo, P.-H. (2019). Sleep apnea may be associated with suicidal ideation in adolescents. *European child & adolescent psychiatry, 28*(5), 635-643.

Tubbs, A. S., Dollish, H. K., Fernandez, F., & Grandner, M. A. (2019). The basics of sleep physiology and behavior *Sleep and Health* (pp. 3-10): Elsevier.

Tucker, R. P., O'Connor, R. C., & Wingate, L. R. (2016). An investigation of the relationship between rumination styles, hope, and suicide ideation through the lens of the integrated motivational-volitional model of suicidal behavior. *Archives of suicide research, 20*(4), 553-566.

Urner, M., Tornic, J., & Bloch, K. E. (2009). Sleep patterns in high school and university students: a longitudinal study. *Chronobiology international, 26*(6), 1222-1234.

Van Orden, K. A., Witte, T. K., Cukrowicz, K. C., Braithwaite, S. R., Selby, E. A., & Joiner Jr, T. E. (2010). The interpersonal theory of suicide. *Psychological review, 117*(2), 575.

Verkooijen, S., De Vos, N., Bakker-Camu, B. J., Branje, S. J., Kahn, R. S., Ophoff, R. A., . . . Boks, M. P. (2018). Sleep Disturbances, Psychosocial Difficulties, and Health Risk Behavior in 16,781 Dutch Adolescents. *Academic pediatrics, 18*(6), 655-661.

Vernon, L., Barber, B. L., & Modecki, K. L. (2015). Adolescent problematic social networking and school experiences: The mediating effects of sleep disruptions and sleep quality. *Cyberpsychology, Behavior, and Social Networking, 18*(7), 386-392.

Waterhouse, J., Reilly, T., Atkinson, G., & Edwards, B. (2007). Jet lag: trends and coping strategies. *The Lancet, 369*(9567), 1117-1129.

Wen, C. K. F., Schneider, S., Stone, A. A., & Spruijt-Metz, D. (2017). Compliance with mobile ecological momentary assessment protocols in children and adolescents: a

systematic review and meta-analysis. *Journal of medical Internet research, 19*(4), e132.

Wensing, M., Bosch, M., & Grol, R. (2010). Developing and selecting interventions for translating knowledge to action. *Cmaj, 182*(2), E85-E88.

Wetherall, K., Robb, K. A., & O'Connor, R. C. (2019). An Examination of Social Comparison and Suicide Ideation Through the Lens of the Integrated Motivational–Volitional Model of Suicidal Behavior. *Suicide and Life-Threatening Behavior, 49*(1), 167-182.

White, D., Leach, C., Sims, R., Atkinson, M., & Cottrell, D. (1999). Validation of the Hospital Anxiety and Depression Scale for use with adolescents. *The British Journal of Psychiatry, 175*(5), 452-454.

Whitlock, J., Muehlenkamp, J., Eckenrode, J., Purington, A., Abrams, G. B., Barreira, P., & Kress, V. (2013). Nonsuicidal self-injury as a gateway to suicide in young adults. *Journal of Adolescent Health, 52*(4), 486-492.

Whitmore, L. M., & Smith, T. C. (2019). Isolating the association of sleep, depressive state, and other independent indicators for suicide ideation in United States teenagers. *Archives of suicide research, 23*(3), 471-490.

Williams, J. M. G., & Williams, M. (2002). *Suicide and attempted suicide: Understanding the cry of pain*: Mark Williams.

Winer, E. S., Cervone, D., Bryant, J., McKinney, C., Liu, R. T., & Nadorff, M. R. (2016). Distinguishing mediational models and analyses in clinical psychology: Atemporal associations do not imply causation. *Journal of clinical psychology, 72*(9), 947-955.

Winsler, A., Deutsch, A., Vorona, R. D., Payne, P. A., & Szklo-Coxe, M. (2015). Sleepless in Fairfax: the difference one more hour of sleep can make for teen hopelessness, suicidal ideation, and substance use. *Journal of Youth and Adolescence, 44*(2), 362-378.

Winsper, C., & Tang, N. K. (2014). Linkages between insomnia and suicidality: prospective associations, high-risk subgroups and possible psychological mechanisms. *International review of psychiatry, 26*(2), 189-204.

Wittmann, M., Dinich, J., Merrow, M., & Roenneberg, T. (2006). Social jetlag: misalignment of biological and social time. *Chronobiology international, 23*(1-2), 497-509.

Wittmann, M., Paulus, M., & Roenneberg, T. (2010). Decreased psychological well-being in late 'chronotypes' is mediated by smoking and alcohol consumption. *Substance use & misuse, 45*(1-2), 15-30.

Wolfson, A. R., & Carskadon, M. A. (1998). Sleep schedules and daytime functioning in adolescents. *Child development, 69*(4), 875-887.

Wolfson, A. R., & Carskadon, M. A. (2003). Understanding adolescent's sleep patterns and school performance: a critical appraisal. *Sleep medicine reviews, 7*(6), 491-506.

Wolfson, A. R., Carskadon, M. A., Acebo, C., Seifer, R., Fallone, G., Labyak, S. E., & Martin, J. L. (2003). Evidence for the validity of a sleep habits survey for adolescents. *Sleep, 26*(2), 213-216.

Wong, M. M., & Brower, K. J. (2012). The prospective relationship between sleep problems and suicidal behavior in the National Longitudinal Study of Adolescent Health. *Journal of psychiatric research, 46*(7), 953-959.

Wong, M. M., Brower, K. J., & Craun, E. A. (2016). Insomnia symptoms and suicidality in the national comorbidity survey–adolescent supplement. *Journal of psychiatric research, 81*, 1-8.

Wong, M. M., Brower, K. J., & Zucker, R. A. (2011). Sleep problems, suicidal ideation, and self-harm behaviors in adolescence. *Journal of psychiatric research, 45*(4), 505-511.

Woods, H. C., & Scott, H. (2016). # Sleepyteens: Social media use in adolescence is associated with poor sleep quality, anxiety, depression and low self-esteem. *Journal of adolescence, 51*, 41-49.

Woznica, A. A., Carney, C. E., Kuo, J. R., & Moss, T. G. (2015). The insomnia and suicide link: toward an enhanced understanding of this relationship. *Sleep medicine reviews, 22*, 37-46.

Yen, C.-F., King, B. H., & Tang, T.-C. (2010). The association between short and long

nocturnal sleep durations and risky behaviours and the moderating factors in Taiwanese adolescents. *Psychiatry research, 179*(1), 69-74.

Yoo, S.-S., Gujar, N., Hu, P., Jolesz, F. A., & Walker, M. P. (2007). The human emotional brain without sleep—a prefrontal amygdala disconnect. *Current biology, 17*(20), R877-R878.

Ystgaard, M., Arensman, E., Hawton, K., Madge, N., van Heeringen, K., Hewitt, A., . . . Fekete, S. (2009). Deliberate self-harm in adolescents: comparison between those who receive help following self-harm and those who do not. *Journal of adolescence, 32*(4), 875-891.

Zhang, J., Paksarian, D., Lamers, F., Hickie, I. B., He, J., & Merikangas, K. R. (2017). Sleep patterns and mental health correlates in US adolescents. *The Journal of pediatrics, 182*, 137-143.

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica, 67*(6), 361-370.

Zschoche, M., & Schlarb, A. A. (2015). Is there an association between insomnia symptoms, aggressive behavior, and suicidality in adolescents? *Adolescent health, medicine and therapeutics, 6*, 29.

Zullo, L., Horton, S., Eaddy, M., King, J., Hughes, J., Diederich, A., . . . Stewart, S. (2017). Adolescent insomnia, suicide risk, and the interpersonal theory of suicide. *Psychiatry research, 257*, 242-248.

Appendix A: Quality Assessment Criteria

	Criteria/Rate	0	1	2	Current Study
Methodology (Maximum of 9)					
1.	Research question (RQ)/ aim	RQ/ aims were not clearly specified.	RQ/ aims were clearly specified, no hypotheses stated.	The RQ/aims were clearly specified; the authors have hypothesised potential findings	
2.	Design	Cross-sectional.	Case-control.	Prospective.	
3.	Statistical Power	No mention of a power calculation.	Power calculation reported, but sufficient power not achieved.	Power achieved.	
4.	Sampling method	Not appropriate for design.	Appropriate for design.		
5.	Data collection	No description of the measurement tool.	Some use of validated tools, or non-validated measurement tools but tools are available or described.	Data collected using valid measurement tools throughout.	
Analysis (Maximum of 3)					
6.	Reliability of analyses	No control for confounding variables.	The study statistically controls for the most important confounding variable (depression or gender).	The study statistically controls for the most important and additional relevant confounding variables (e.g. other sleep problems, anxiety).	
7.	Analysis is appropriate for RQ and aims	The test is not appropriate, not clearly described or incomplete.	Statistical test used to analyse the data is suitable and clearly described. Data reported in appropriate detail for the given statistical test e.g. confidence intervals, probability level (p value).		

Appendix B: Sleep Condition Indicator

Thinking about a typical night in the last month . . .					
1. . . . how long does it take you to fall asleep?	0-15 min	16-30 min	31-45 min	46-60 min	>60 min
2. . . . if you then wake up during the night, how long are you awake for in total? *(add up all the wakenings)*	0-15 min	16-30 min	31-45 min	46-60 min	>60 min
3. . . . if your final wake up time occurs before you intend to wake up, how much earlier is this?	I don't wake up too early/Up to 15 min early	16-30 min early	31-45 min early	46-60 min early	>60 min early
4. . . . how many nights a week do you have a problem with your sleep?	0-1	2	3	4	5-7
5. . . . how would you rate your sleep quality?	Very good	Good	Average	Poor	Very poor
Thinking about the past month, to what extent has poor sleep . . .					
6. . . . affected your mood, energy or relationships?	Not at all	A little	Somewhat	Much	Very much
7. . . . affected your concentration, productivity, or ability to stay awake?	Not at all	A little	Somewhat	Much	Very much
8. . . . troubled you in general?	Not at all	A little	Somewhat	Much	Very much
Finally . . .					
9. . . . how long have you had a problem with your sleep?	I don't have a problem/ < 1 month	1-2 months	3-6 months	7-12 months	>1 year

Appendix C: Munich Chronotype Questionnaire (Pupil Version)

1. **Do you have a regular school schedule (this also applies if you have to get up at certain times because your parents/siblings have to get up regularly** – Yes/ No (Please circle)

2. **If YES how many days of the week is that true?** ___ Days.

ON SCHOOL DAYS We understand that the times we are asking for may vary. Please provide an average time rather than saying that it depends on the day. Thanks!	
What time do you go to bed on a school night?	
When do you actually get ready to fall asleep? Please note some people stay awake for some time when in bed!	
How many minutes does it take you to fall asleep?	
What time do you wake up at on a school day?	
Do you get woken up by an alarm clock/your parents or do you wake up by yourself?	
After how many minutes do you get up?	
On average, how long per day to you spend outside exposed to sunlight (without a roof above your head)?	_____ hours _____ minutes
Once you are in bed on a school night do you continue to use technology (e.g. mobile phone, laptop, TV)? If yes please indicate what technology you use and how long for.	
ON FREE DAYS (e.g. weekends) We understand that the times we are asking for may vary. Please provide an average time rather than saying that it depends on the day. Thanks!	
What time do you go to bed on a free night?	

When do you actually get ready to fall asleep? Please note some people stay awake for some time in bed!	
How many minutes does it take you to fall asleep?	
What time do you wake up at on a free day?	
Do you get woken up by an alarm clock/your parents? or do you wake up by yourself?	
After how many minutes do you get up?	
On average, how long per day to you spend outside exposed to sunlight (without a roof above your head)?	_____ hours _____ minutes
Once you are in bed on a free night do you continue to use technology (e.g. mobile phone, laptop, TV)? If yes please indicate what technology you use and how long for.	
Please leave a comment here if you currently have no possibility of freely choosing your sleep times on free days (e.g. because of pets, parents that might wake you etc.)	

Appendix D: Disturbing Dream and Nightmare Severity Index

1. How often do you have disturbing dreams and/or nightmares: (Circle one, then follow the arrow)

Never ⟶ STOP HERE: NO OTHER QUESTIONS NEED TO BE ANSWERED

Yearly

Monthly

Weekly

| How many **NIGHTS** in **a week** do you have disturbing dreams and/or nightmares? 1 2 3 4 5 6 7 | How many **NIGHTS** in **a month** do you have disturbing dreams and/or nightmares? 1   2   3 | How many **NIGHTS** in **a year** do you have disturbing dreams and/or nightmares? 1 2 3 4 5 6 7 8 9 10 11 |
| How many **disturbing dreams and/or nightmares** do you have in **a week**? _____ | How many **disturbing dreams and/or nightmares** do you have in **a month**? _____ | How many **disturbing dreams and/or nightmares** do you have in **a year**? _____ |

GO TO QUESTION #2

STOP HERE

2. Please estimate the NUMBER of months or years you have had disturbing dreams and/or nightmares:

_____months _____years

3. On average, do your nightmares wake you up? (Circle answer)

Never/Rarely   Occasionally   Sometimes   Frequently   Always

4. How would you rate the SEVERITY of your disturbing dreams and/or nightmare problem? (Circle answer)

| No Problem | Minimal Problem | Mild Problem | Moderate Problem | Severe Problem | Very Severe Problem | Extremely Severe Problem |

5. How would you rate the INTENSITY of your disturbing dreams and/or nightmares? (Circle answer)

| Not Intense | Minimal Intensity | Mild Intensity | Moderate Intensity | Severe Intensity | Very Severe Intensity | Extreme Intensity |

Appendix E: Hospital Anxiety and Depression Scale

Tick the box beside the reply that is closest to how you have been feeling in the past week. Don't take too long over your replies: your immediate is best

1. I feel tense or "wound up":
- ☐ Most of the time
- ☐ A lot of the time
- ☐ From time to time, occasionally
- ☐ Not at all

2. I still enjoy the things I used to enjoy:
- ☐ Definitely as much
- ☐ Not quite so much
- ☐ Only a little
- ☐ Hardly at all

3. I get a sort of frightened feeling as if something awful is about to happen:
- ☐ Very definitely and quite badly
- ☐ Yes, but not too badly
- ☐ A little, but it doesn't worry me
- ☐ Not at all

4. I can laugh and see the funny side of things:
- ☐ As much as I always could
- ☐ Not quite so much now
- ☐ Definitely not so much now
- ☐ Not at all

5. Worrying thoughts go through my mind:
- ☐ A great deal of the time
- ☐ A lot of the time
- ☐ From time to time, but not too often
- ☐ Only occasionally

6. I feel cheerful:
- ☐ Not at all
- ☐ Not often
- ☐ Sometimes
- ☐ Most of the time

7. I can sit at ease and feel relaxed:
- ☐ Definitely
- ☐ Usually
- ☐ Not often
- ☐ Not at all

8. I feel as if I am slowed down:
- ☐ Nearly all of the time
- ☐ Very often
- ☐ Sometimes
- ☐ Not at all

9. I get a sort of frightened feeling like "butterflies" in the stomach:
- ☐ Not at all
- ☐ Occasionally
- ☐ Quite often
- ☐ Very often

10. I have lost interest in my appearance:
- ☐ Definitely
- ☐ I don't take as much care as I should
- ☐ I may not take quite as much care
- ☐ I take just as much care as ever

11. I feel restless as though I have to be on the move:
- ☐ Very much indeed
- ☐ Quite a lot
- ☐ Not very much
- ☐ Not at all

12. I look forward to enjoyment with things
- ☐ As much as I ever did
- ☐ Rather less than I used to
- ☐ Definitely less than I used to
- ☐ Hardly at all

13. I get sudden feelings of panic
- ☐ Very often indeed
- ☐ Quite often
- ☐ Not very often
- ☐ Not at all

14. I can enjoy a good book or radio or TV program:
- ☐ Often
- ☐ Sometimes
- ☐ Not often
- ☐ Seldom

Appendix F: Defeat Scale

Please read the following statements carefully and indicate how often you have felt like this in the past 7 days by circling a response on the scale

1. I feel I have not made it in life	Never	Rarely	Sometimes	Mostly	Always
2. I feel that I am a successful person	Never	Rarely	Sometimes	Mostly	Always
3. I feel defeated by life	Never	Rarely	Sometimes	Mostly	Always
4. I feel that I am basically a winner	Never	Rarely	Sometimes	Mostly	Always
5. I feel that I have lost my standing in the world	Never	Rarely	Sometimes	Mostly	Always
6. I feel that life has treated me like a punch bag	Never	Rarely	Sometimes	Mostly	Always
7. I feel powerless	Never	Rarely	Sometimes	Mostly	Always
8. I feel that my confidence has been knocked out of me	Never	Rarely	Sometimes	Mostly	Always
9. I feel able to deal with whatever life throws at me	Never	Rarely	Sometimes	Mostly	Always
10. I feel that I have sunk to the bottom of the ladder	Never	Rarely	Sometimes	Mostly	Always
11. I feel completely knocked out of action	Never	Rarely	Sometimes	Mostly	Always
12. I feel that I am one of life's losers	Never	Rarely	Sometimes	Mostly	Always
13. I feel that I have given up	Never	Rarely	Sometimes	Mostly	Always
14. I feel down and out	Never	Rarely	Sometimes	Mostly	Always
15. I feel that I have lost important battles in life	Never	Rarely	Sometimes	Mostly	Always
16. I feel there I no fight left in me	Never	Rarely	Sometimes	Mostly	Always

Appendix G: Entrapment Scale

Please read each of the following statements carefully and indicate how much you feel like this by circling a response on the scale

1. I want to get away from myself	Not at all	A little	Moderately	Quite a bit	Extremely
2. I feel powerless to change myself	Not at all	A little	Moderately	Quite a bit	Extremely
3. I would like to escape my thoughts and feelings	Not at all	A little	Moderately	Quite a bit	Extremely
4. I feel trapped inside myself	Not at all	A little	Moderately	Quite a bit	Extremely
5. I would like to get away from who I am and start again	Not at all	A little	Moderately	Quite a bit	Extremely
6. I feel I am in a deep hole I can't get out of	Not at all	A little	Moderately	Quite a bit	Extremely
7. I am in a situation I feel trapped in	Not at all	A little	Moderately	Quite a bit	Extremely
8. I have a strong desire to escape from things in my life	Not at all	A little	Moderately	Quite a bit	Extremely
9. I am in a relationship I can't get out of	Not at all	A little	Moderately	Quite a bit	Extremely
10. I often have the feeling that I would like to just run away	Not at all	A little	Moderately	Quite a bit	Extremely
11. I feel powerless to change things	Not at all	A little	Moderately	Quite a bit	Extremely
12. I feel trapped by my obligations	Not at all	A little	Moderately	Quite a bit	Extremely
13. I can see no way out of my current situation	Not at all	A little	Moderately	Quite a bit	Extremely
14. I would like to get away from other more powerful people in my life	Not at all	A little	Moderately	Quite a bit	Extremely
15. I have a strong desire to get away and stay away from where I am now	Not at all	A little	Moderately	Quite a bit	Extremely
16. I feel trapped by other people	Not at all	A little	Moderately	Quite a bit	Extremely

Appendix H: Modified Consensus Sleep Diary

Sleep Diary Instructions (CSD)

General Instructions

What is a Sleep Diary? A sleep diary is designed to gather information about your daily sleep pattern.

How often and when do I fill out the sleep diary? It is necessary for you to complete your sleep diary <u>every day</u>. If possible, the sleep diary should be completed within one hour of getting out of bed in the morning. The Nighttime Sleep Diary questions can be completed before you go to bed at night.

What should I do if I miss a day? If you forget to fill in the diary or are unable to finish it, leave the diary blank for that day.

What if something unusual affects my sleep or how I feel in the daytime? If your sleep or daytime functioning is affected by some unusual event (such as an illness, or an emergency) you may make brief notes on your diary.

What do the words "bed" and "day" mean on the diary? This diary can be used for people who are awake or asleep at unusual times. In the sleep diary, the word "day" is the time when you choose or are required to be awake. The term "bed" means the place where you usually sleep.

Will answering these questions about my sleep keep me awake? This is not usually a problem. You should not worry about giving exact times, and you should not watch the clock. Just give your best estimate.

Morning Sleep Diary Item Instructions

Use the guide below to clarify what is being asked for each item of the Sleep Diary.

Date: Write the date of the morning you are filling out the diary.

1. What time did you get into bed? Write the time that you got into bed. This may not be the time you began "trying" to fall asleep.

2. What time did you try to go to sleep? Record the time that you began "trying" to fall asleep.

3. How long did it take you to fall asleep? Beginning at the time you wrote in question 2, how long did it take you to fall asleep.

4. How many times did you wake up, not counting your final awakening? How many times did you wake up between the time you first fell asleep and your final awakening?

5. In total, how long did these awakenings last? What was the total time you were awake between the time you first fell asleep and your final awakening. For example, if you woke 3 times for 20 minutes, 35 minutes, and 15 minutes, add them all up (20+35+15= 70 min or 1 hr and 10 min).

6a. What time was your final awakening? Record the last time you woke up in the morning.

6b. After your final awakening, how long did you spend in bed trying to sleep? After the last time you woke-up (Item #6a), how many minutes did you spend in bed trying to sleep? For example, if you woke up at 8 am but continued to try and sleep until 9 am, record 1 hour.

6c. Did you wake up earlier than you planned? If you woke up or were awakened earlier than you planned, check yes. If you woke up at your planned time, check no.

6d. If yes, how much earlier? If you answered "yes" to question 6c, write the number of minutes you woke up earlier than you had planned on waking up. For example, if you woke up 15 minutes before the alarm went off, record 15 minutes here.

7. What time did you get out of bed for the day? What time did you get out of bed with no further attempt at sleeping? This may be different from your final awakening time (e.g. you may have woken up at 6:35 a.m. but did not get out of bed to start your day until 7:20 a.m.)

8. In total, how long did you sleep? This should just be your best estimate, based on when you went to bed and woke up, how long it took you to fall asleep, and how long you were awake. You do not need to calculate this by adding and subtracting; just give your best estimate.

9. How would you rate the quality of your sleep? "Sleep Quality" is your sense of whether your sleep was good or poor.

10. How restful or refreshed did you feel when you woke up for the day? This refers to how you felt after you were done sleeping for the night, during the first few minutes that you were awake.

11. Did you take your actiwatch off yesterday? If yes- for how long. This refers to times when you took the actiwatch off- such as when showering or when swimming.

Nighttime Sleep Diary Item Instructions

Please complete the following items before you go to bed.
Date: Write the date of the evening you are filling out the diary.
11a. How many times did you nap or doze? A nap is a time you decided to sleep during the day, whether in bed or not in bed. "Dozing" is a time you may have nodded off for a few minutes, without meaning to, such as while watching TV. Count all the times you napped or dozed at any time from when you first got out of bed in the morning until you got into bed again at night.

11b. In total, how long did you nap or doze? Estimate the total amount of time you spent napping or dozing, in hours and minutes. For instance, if you napped twice, once for 30 minutes and once for 60 minutes, and dozed for 10 minutes, you would answer "1 hour 40 minutes." If you did not nap or doze, write "N/A" (not applicable).

11c. Did you spend any time in a quiet restful state (not including naps) with little movement? If yes, please indicate what times and for how long. In this include things such as reading, lying still or any other times you were inactive but not sleeping.

12a. How many drinks containing alcohol did you have? Enter the number of alcoholic drinks you had where 1 drink is defined as one 12 oz beer (can), 5 oz wine, or 1.5 oz liquor (one shot).

12b. What time was your last drink? If you had an alcoholic drink yesterday, enter the time of day in hours and minutes of your last drink. If you did not have a drink, write "N/A" (not applicable).

13a. How many caffeinated drinks (coffee, tea, soda, energy drinks) did you have? Enter the number of caffeinated drinks (coffee, tea, soda, energy drinks) you had where for coffee and tea, one drink = 6-8 oz; while for caffeinated soda one drink = 12 oz.

13b. What time was your last drink? If you had a caffeinated drink, enter the time of day in hours and minutes of your last drink. If you did not have a caffeinated drink, write "N/A" (not applicable).

14. Did you take any over-the-counter or prescription medication(s) to help you sleep? If so, list medication(s), dose, and time taken: List the medication name, how much and when you took EACH different medication you took tonight to help you sleep. Include medication available over the counter, prescription medications, and herbals (example: "Sleepwell 50 mg 11 pm"). If every night is the same, write "same" after the first day

15. Comments If you have anything that you would like to say that is relevant to your sleep feel free to write it here.

1. What time did you get into bed?	10:15 p.m.						
2. What time did you try to go to sleep?	11:30 p.m.						
3. How long did it take you to fall asleep?	55 min.						
4. How many times did you wake up, not counting your final awakening?	6 times						
5a. In total, how long did these awakenings last?	2 hours 5 min.						
5b Were any of these awakenings because of a disturbing dream or nightmare?	☐ Yes ☐ No						
5c. If yes, how vivid was the disturbing dream or nightmare?	☐ Not at all ☐ A little ☐ Moderately ☐ Very much so ☐ Extremely						
5d. If yes, how intense was the disturbing dream or nightmare?	☐ Not at all ☐ A little ☐ Moderately ☐ Very much so ☐ Extremely						
5e. If yes, how distressing was the disturbing dream or nightmare?	☐ Not at all ☐ A little ☐ Moderately ☐ Very much so ☐ Extremely						

6a. What time was your final awakening?	6:35 a.m.							
6b. After your final awakening, how long did you spend in bed trying to sleep?	45 min.							
6c. Did you wake up earlier than you planned?	☒ Yes □ No	□ Yes □ No	□ Yes □ No	□ Yes □ No	□ Yes □ No	□ Yes □ No	□ Yes □ No	□ Yes □ No
6d. If yes, how much earlier?	1 hour							
7. What time did you get out of bed for the day?	7:20 a.m.							
8. In total, how long did you sleep?	4 hours 10 min.							
9. How would you rate the quality of your sleep?	□ Very poor ☒ Poor □ Fair □ Good □ Very good							
10. How rested or refreshed did you feel when you woke-up for the day?	□ Not at all rested ☒ Slightly rested □ Somewhat rested □ Well-rested □ Very well-rested							
11. Did you take your actiwatch off yesterday? If so- for how long (minutes) If yes, which time(s)? Please indicate if AM/PM	Time taken off: 7-7.15pm	□ Yes □ No	□ Yes □ No	□ Yes □ No	□ Yes □ No	□ Yes □ No	□ Yes □ No	□Yes □ No

11a. How many times did you nap or doze? 11b. In total, how long did you nap or doze?	2 times 1 hour 10 min.						
11c. Did you spend any time in a quiet restful state (not including naps) with little movement? If yes, please indicate what times and for how long.	Yes (reading) 4-5pm 1hour						
12a. How many drinks containing alcohol did you have? 12b. What time was your last drink?	3 drinks 9 :20 p.m.						
13a. How many caffeinated drinks (coffee, tea, soda, energy drinks) did you have? 13b. What time was your last drink?	2 drinks 3 :00 p.m.						
14. Did you take any over-the-counter or prescription medication(s) to help you sleep? If so, list medication(s), dose, and time taken	☑ Yes ▢ No Medication(s): Relaxo-Herb Dose: 50 mg Time(s) taken: 11 pm	▢Yes ▢No Medication(s): Dose: Time(s) taken:	▢Yes ▢No Medication(s): Dose: Time(s) taken:	▢Yes ▢No Medication(s): Dose: Time(s) taken:	▢Yes ▢No Medication(s): Dose: Time(s) taken:	▢Yes ▢No Medication(s): Dose: Time(s) taken:	▢Yes ▢No Medication(s): Dose: Time(s) taken:	▢Yes ▢No Medication(s): Dose: Time(s) taken:
16. Comments (if applicable	I have a cold						

Appendix I: Papers Published or Submitted During PhD

Russell, K., Rasmussen, S., Morrison, R., Martin, B., & Hunter, S. C. (Under Review) Examining the role of sleep disturbance in relation to suicide and self-harm risk during adolescence: A systematic review and research agenda. *Clinical Psychology Reviews*.

Littlewood, D.L. & Russell, K. (2019) Is there a role for sleep medicine in suicide prevention? *Sleep Medicine*

Russell, K., Allan, S., Beattie, L., Bohan, J., MacMahon, K., & Rasmussen, S. (2019). Sleep problem, suicide and self-harm in university students: A systematic review. *Sleep Medicine Reviews*, 44, 58-69.

Russell, K., Rasmussen, S., & Hunter, S. C. (2018). Insomnia and nightmares as markers of risk for suicidal ideation in young people: investigating the role of defeat and entrapment. *Journal of Clinical Sleep Medicine*, 14(05), 775-784.

Russell, K (2017) Is prioritising sleep the first step in academic self-care? Tips for getting a good night's sleep during postgraduate study. *PsyPAG Quarterly*.

Russell, K (2017) The importance of starting a conversation about suicide: Hints and tips for supporting postgraduate peers. *PsyPAG Quarterly*.

Appendix J: Supplementary Materials for Serial Multiple Mediation Analyses & Confirmatory Factor Analyses Presented in Chapter 5.

Point estimates for total, direct and indirect effects and 95% bias corrected confidence intervals for serial multiple mediation analysis in which defeat, and internal entrapment (E) were represented as mediators in the association between insomnia and self-harm thoughts (controlling for depression, history of self-harm thoughts and internal entrapment.

Multiple Mediation Pathways	Point Estimate	95% confidence intervals [a]	
		Lower	Upper
Total effect of Insomnia on SHT	.71		
Insomnia > SHT	.55	-.14	1.23
Insomnia > Defeat > Internal Entrapment > SHT	.16	.03	.37
Total effect of Insomnia on Internal Entrapment	2.76		
Insomnia > Internal Entrapment	1.24	.47	2.02
Insomnia > Defeat > Internal Entrapment	1.52	.67	2.41
Insomnia > Defeat	4.86	2.35	7.37
Defeat > Internal Entrapment	.29	.27	.32
Internal Entrapment > SHT	.12	.04	.19

Point estimates for total, direct and indirect effects and 95% bias corrected confidence intervals for serial multiple mediation analysis in which defeat, and internal entrapment (E) were represented as mediators in the association between insomnia and self-harm thoughts (controlling for depression, history of self-harm thoughts and external entrapment.

Multiple Mediation Pathways	Point Estimate	95% confidence intervals [a]	
		Lower	Upper
Total effect of Insomnia on SHT	.62		
Insomnia > SHT	.55	-.14	1.23
Insomnia > Defeat > External Entrapment > SHT	.07	-14	.19
Total effect of Insomnia on External Entrapment	2.88		
Insomnia > External Entrapment	1.03	-.18	2.24
Insomnia > Defeat > External Entrapment	1.85	.83	2.94
Insomnia > Defeat	4.86	2.35	7.37
Defeat > External Entrapment	0.36	0.32	0.40
External Entrapment > SHT	.04	.04	.19

a Statistical significance indicated by confidence intervals not containing 0.

Standardized loading of each item on its hypothesized factor for unidimensional and dimensional factor structures derived from a confirmatory factor analyses of the Entrapment scale (internal entrapment items are in bold).

Entrapment Item	Unidimensional	Bidimensional
I am in a situation that I feel trapped in	.728	.857
I have a strong desire to escape from things in my life	.656	.802
I am in a relationship I can't get out of	.693	.833
I often have the feeling that I would like to just run away	.731	.855
I feel powerless to change things	.673	.816
I feel trapped by my obligations	.724	.849
I can see no way out of my current Situation	.704	.829
I would like to get away from other more powerful people in my life	.700	.821
I have a strong desire to get away and stay away from other more powerful people in my life	.120	.319
I feel trapped by other people	.650	.780
I want to get away from myself	.723	.854
I feel powerless to change myself	.620	.785
I would like to escape from my thoughts and feelings	.670	.820
I feel trapped inside myself	.539	.722
I would like to get away from who I am and start again	.584	.745
I feel I'm in a deep hole I can't get out of	.616	.779

Appendix K: Supplementary Materials for Confirmatory Factor Analyses on Baseline Entrapment Scale Data (Collected during the Micro-longitudinal Study presented in Chapter 6)

Model fit statistics for both one and two Entrapment Scale factor structure solutions are presented in the table below. Based on a) CFI (i.e., >0.90), b) RMSEA (i.e., ≤0.10) and, c) BIC (i.e., higher for the one factor structure), the two-factor model demonstrated better fit compared to the one factor alternative solution. Factor loadings for internal (λ range = 0.36 to 0.91, all p values < .001) and external entrapment (λ range = 0.72 to 0.86, all p values < .001) were all significant and positive

Entrapment scale confirmatory factor analysis (CFA) model fit statistics

	X^2 (df), p-value	X/df	CFI	TLI	RMSEA (90% CI)	BIC
1. One factor	433.57 (104), p<0.001	4.16	.874	.836	.13 (.10,13)	538.68
2.Two factor	377.10 (103), p<0.001	3.66	.901	.862	.10 (.04,12)	485.38

Note, df = Degrees of freedom; CFI = Comparative fit index; TLI = Tucker–Lewis Index; RMSEA = Root mean square error of approximation; BIC = Bayesian Information Criteria

Standardized loading of each item on its hypothesized factor for unidimensional and dimensional factor structures derived from a confirmatory factor analyses of the Entrapment scale (internal entrapment items are in bold).

Entrapment Item	Unidimensional	Bidimensional
I am in a situation that I feel trapped in	.823	.872
I have a strong desire to escape from things in my life	.765	.760
I am in a relationship I can't get out of	.774	.790
I often have the feeling that I would like to just run away	.893	.911
I feel powerless to change things	.751	.765
I feel trapped by my obligations	.856	.901
I can see no way out of my current Situation	.873	.864
I would like to get away from other more powerful people in my life	.807	.802
I have a strong desire to get away and stay away from other more powerful people in my life	.369	.363
I feel trapped by other people	.723	.772
I want to get away from myself	.833	.875.
I feel powerless to change myself	.742	.763
I would like to escape from my thoughts and feelings	.795	.841
I feel trapped inside myself	.657	.738
I would like to get away from who I am and start again	.783	.824
I feel I'm in a deep hole I can't get out of	,656	.732