University of Strathclyde

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Implementation of physical activity services for the management of adults with Type 2 Diabetes

by

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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.

Signed: Date:

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ABSTRACT

Physical activity plays an integral role in management of Type 2 diabetes. Despite strong evidence, a limited number of physical activity interventions have been implemented within routine diabetes care. The aim of this research is to explore the practical issues related to translation, implementation and evaluation of physical activity interventions delivered in everyday settings.

Chapters 1-2 introduce the topic and presents the current literature. Chapter 3 presents a systematic review of physical activity interventions delivered within everyday practice. Findings from 12 articles demonstrate that although 66.7% of interventions (n=8) reported an increase in physical activity levels, few publications reported information on intervention translation and implementation. Chapter 4 uses qualitative interviews and an online survey to explore the insight of health professionals on physical activity promotion within routine care. Findings conclude that physical activity promotion could be improved by: (1) having a key member of staff responsible for physical activity promotion, (2) a referral route for physical activity support, (3) behaviour change training for staff, (4) linking delivery of physical activity with clinical outcomes, and (5) using ‘champions’ to raise the profile of physical activity within the health service. Chapter 5 presents findings from a process evaluation of a physical activity consultation intervention delivered within routine diabetes care. Results show that an evidence-based protocol can effectively promote physical activity and improve health outcomes in adults with diabetes. Several practical issues were identified including the need for flexibility in the intervention protocol and the role of ‘champions’ to promote adoption of the intervention. Chapter 6 collates findings from each study to provide recommendations on translation, implementation and evaluation of physical activity interventions within routine diabetes care. This thesis demonstrates that delivery of physical activity interventions within routine diabetes care is challenging and complex. The recommendations should guide and support this process.

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Matthews L, Kirk A, & Mutrie N. (2014). Insight from health professionals on physical activity promotion within routine diabetes care. *Practical Diabetes,* 31(3), 111-116.

Matthews L, Kirk A, MacMillan F, & Mutrie N. (2013). Can physical activity interventions for adults with type diabetes be translated into practice settings? A systematic review using the RE-AIM framework. *Translational Behavioural Medicine.* First published online 29th September 2013, doi 10.1007/s13142-013-0235-y.

Matthews L, Kirk A, Mutrie N, McCallum M, Gold A, & Keen A. The feasibility, effectiveness and implementation of a physical activity consultation service for adults within routine diabetes care. [In preparation].

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Matthews L, Kirk A, & Mutrie N. Recommendations for the translation, implementation and evaluation of physical activity interventions within routine diabetes care. [In preparation].

Conference presentations from this thesis

McCallum M, **Matthews L**, Kirk A, Mutrie N, Gold A. (2014). Implementing a physical activity consultation service for adults with diabetes: promising results from a 12 month evaluation. *Diabetic Medicine*, 31(s1-P418),153. [Diabetes UK Annual Conference, Liverpool, UK].

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McCallum M, **Matthews L**, Gold A, Keen A, Kirk A, Mutrie N. (2013). The evaluation of a physical activity consultation service for adults with diabetes: Promising results from 12-month follow-up. *Submitted to Diabetes UK Professional Conference (Oct 2013). Awaiting decision.*

Publications in related areas

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Conference presentations for related research

MacMillan F, Robertson K, **Matthews L**, Mutrie N, Kirk A. (2013). Designing a physical activity intervention study for youth with Type 1 diabetes: lessons learned from a systematic review. *Diabetic Medicine,* 30(s1-P65),14. [Diabetes UK Annual Conference, Manchester, UK].

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CAREER PATHWAY LEADING TO PhD

As a qualified health and fitness instructor I have always had a keen interest in physical activity research. Following graduation with a medical degree (MBChB) from the University of Dundee I chose to develop my career in this field. With my medical background I was particularly interested in the role of physical activity in specialist and clinical populations. This naturally led on to an MSc in Medicine and Science in Sport and Exercise (Universities of the City of Glasgow) for which my dissertation explored the insight of individuals with Multiple Sclerosis on their participation of a home-based physical activity programme. My first research post, with Dr Craig Melville of the University of Glasgow, provided further development of research skills and interests while working on the TAKE-5 Study (a lifestyle weight loss intervention for adults with intellectual disabilities).

My experience in the health and fitness industry highlighted the limited physical activity services available for specialist and clinical populations. This inspired me to found the award winning social enterprise, Active Health Scotland (2006-2009). Supported by the Princes Youth Business Trust for Scotland, the organisation specialised in providing safe and effective physical activity services for individuals with a range of physical, mental wellbeing and clinical needs. My lead role in Active Health Scotland involved close liaison with NHS departments, Scottish Government and other organisations. Despite its success Active Health Scotland was challenged with multiple barriers to funding, implementation and adoption. The organisation closed in 2009 and it was at this point I chose to explore the challenging process of implementing sustainable physical activity services for health.

The opportunity arose to develop a PhD proposal with Dr Alison Kirk and Professor Mutrie in the area of diabetes management. I was consequently awarded a PhD scholarship to explore '*the implementation of physical activity services for the management of adults with Type 2 diabetes'*.

THESIS OVERVIEW

Research Questions

Physical inactivity and Type 2 diabetes are both global public health issues. Although the relationship between physical activity and Type 2 diabetes has been widely researched and reported minimal progress has been made in the implementation of research findings within everyday practice. The challenge of translating these research findings into effective, sustainable programmes is the focus of this PhD.

The thesis has been structured in the form of four individual manuscripts which have been, or will be in the near future, submitted for publication (Chapters 3 to 6). Each paper is guided by specific research aims. Overall, this PhD aims to contribute to the existing literature by addressing three research questions:

- **Research Question 1:** What issues are associated with the design, translation and implementation of physical activity interventions for individuals with Type 2 diabetes in an everyday routine care setting?
- **Research Question 2:** What are the views and attitudes of health professionals towards current and future physical activity promotion within routine diabetes care?
- **Research Question 3:** What are the key elements of effective implementation of physical activity services within routine diabetes care?

The research questions are outlined in detail at the end of Chapter 2, following a comprehensive discussion of the literature.

Thesis Structure

Chapter 1 provides an introduction to the reader with an overview of the three interlinking components of this PhD: (1) Type 2 diabetes, (2) physical activity, and (3) translational research. Chapter 2 presents a literature review which builds on the introductory information by discussing the available literature on physical activity behaviour change in people with Type 2 diabetes. Appraisal of the evidence-base highlights several important research gaps which this research aims to address.

Chapters 3 – 6 are presented as manuscripts prepared in the style of peer reviewed journals. Chapter 3 presents a systematic review of physical activity interventions for adults with Type 2 diabetes which report findings related to translation and implementation within everyday practice. Findings from this chapter highlight the practical intervention issues which need addressed when designing and delivering physical activity interventions for implementation within routine diabetes care. This manuscript has been published in the peer-reviewed journal *Translational Behavioural Medicine.* As lead author I was responsible for the design of the systematic review protocol, data collection and analysis. I led the initial draft of the manuscript and subsequent drafts following feedback from my co-authors.

Chapter 4 reports the findings from a qualitative study undertaken with health professionals throughout NHS Scotland. The aim of this paper is to explore the insights of health professionals on the current and future delivery of physical activity promotion within routine diabetes care. This manuscript has been prepared for submission to the peer-reviewed journal *Implementation Science.* I was responsible for the design of the methodology, recruitment of participants and networking with external organisations. I performed all qualitative data collection, interview transcription and overall analysis. My co-authors contributed to the review of interview transcripts and qualitative findings, in addition to providing feedback on the overall manuscript.

Chapter 5 presents the findings from an in-depth process evaluation of a pilot physical activity consultation service undertaken within a routine diabetes care setting in NHS Grampian. Colleagues from NHS Grampian approached our PhD team to discuss options for evaluating their proposed physical activity consultation service in mid-2010. This presented an excellent opportunity for me to conduct an evaluation of a physical activity intervention conducted within an everyday setting. It is important to clarify that the choice of intervention (i.e. physical activity consultation) was presented to our PhD team by colleagues in NHS Grampian and was not a choice made by me based on background research or the findings of my PhD (Chapters 2-4). I contributed to the initial design of the physical activity consultation protocol in collaboration with my colleagues in NHS Grampian. Following which I was responsible for the on-going process evaluation of the intervention. This involved the design, data collection and analysis of all process measures. I led the preparation of the manuscript presented in Chapter 5 in collaboration with feedback from my co-authors. The manuscript has been prepared for the peer-reviewed journal, *Diabetes Care.* However, due to the breadth of process information collected by the process evaluation my co-authors and I intend to publish the findings as two individual manuscripts.

Chapter 6 collates findings from each stage of this PhD research to provide recommendations for translation, implementation and evaluation of future physical activity interventions within routine diabetes care. This manuscript has been prepared for submission to the journal *Implementation Science.* As lead author I was responsible for the collation and interpretation of research findings presented in the manuscript. I drafted the initial manuscript and responded to comments from my co-authors to prepare the final manuscript. Chapter 7 summarises the overall PhD findings and highlights the contribution this research has made to translational research in the field of physical activity and Type 2 diabetes.

Due to the thesis being structured as individual manuscripts the background sections of each paper often provide similar information. This is unavoidable but acknowledged and is a reflection of the structure of this thesis. This approach has particular advantages for the publication and dissemination of the PhD research findings. I have therefore gained valuable experience in the preparation, revision and submission of research manuscripts for peer-reviewed publication.

CHAPTER 1

Introduction

1.1 Overview

Type 2 diabetes is well established as an international public health problem affecting approximately 10% of the global population (World Health Organisation, 2013). The deteriorating nature of diabetes impacts on patients' long term quality of life and also places a huge economic burden on the health service. For example, 12.6% and 10.8% of the annual UK health care cost is spent on inpatient and outpatient diabetes care respectively (Morgan, Peters, Dixon, & Currie, 2010). Implementation of pioneering and forward thinking services, based on up to date evidence, is therefore required to manage this substantial public health problem.

There is a strong evidence base for the use of physical activity as a management tool within diabetes care (Chudyk & Petrella, 2011; Colberg & Grieco, 2009; Thomas, Elliott, & Naughton, 2006). However, there are still steps to be taken to bridge the gap between the research evidence base and public health policy and practice. For example, in the recent Diabetes Action Plan for Scotland, 52 individual action points were identified to improve diabetes care in Scotland, but with the clear omission of an action point targeting physical activity (Scottish Government, 2010). Importantly, very few physical activity interventions have been translated into everyday diabetes practice, resulting in limited evaluation of physical activity interventions within routine diabetes care.

Given the lack of priority placed on physical activity within diabetes care, it is perhaps not surprising that the majority of people living with diabetes do not meet the current physical activity guidelines of 150 minutes of moderate intensity activity accumulated over the week (Department of Health, 2011a; Morrato, Hill, Wyatt, Ghushchyan, & Sullivan, 2007). Current guidelines for the management of Type 2 diabetes specifically state the importance of providing people with physical activity services that support behaviour change, via individually tailored methods based on valid theoretical frameworks (Scottish Intercollegiate Guidelines Network, 2010).

The research undertaken for this PhD explores the translation of evidence based physical activity interventions for implementation in everyday practice for people with Type 2 diabetes. In this introductory chapter, a brief overview of the key terms of this thesis, namely diabetes, physical activity and translational research, will be provided.

1.2 Diabetes

1.2.1 What is diabetes?

Diabetes is a chronic deteriorating condition, resulting in long-term damage throughout the body due to the harmful effects of raised blood glucose levels (hyperglycaemia). The metabolic hormone, insulin, plays an integral role in the control of blood glucose levels. In instances where insulin is absent, or ineffective, sugar remains in the bloodstream instead of being removed and stored in the body for energy. Various forms of diabetes exist, however, the two main forms are Type 1 and Type 2 diabetes, both of which differ significantly in terms of onset, pathophysiology and management (outlined in Table 1.1) (World Health Organisation, 2011).

Type 2 diabetes is the most common form of the condition, representing 90% of people with diabetes worldwide (World Health Organisation, 2011). People with a family history have a greater risk of developing Type 2 diabetes (Herder & Roden, 2011). However, there is an established link between Type 2 diabetes and lifestyle factors, including: overweight and obesity, low levels of physical activity, high levels of sedentary behaviour, and poor nutrition in the form of a high fat/sugar diet (Nolan, Damm, & Prentki, 2011; Unger & Scherer, 2010).

Table 1.1. Characteristics of Type 1 and Type 2 diabetes (adapted from World Health Organisation, 2011)

	Type 1 Diabetes	**Type 2 Diabetes**
Onset	Typical onset in childhood	Typical onset in adulthood
Pathophysiology	Failure of the body to produce sufficient levels of insulin to control blood glucose levels. The cause of T1D is currently unknown.	Reduced production or inefficient use of insulin produced by the pancreas. Commonly referred to as ‘insulin insensitivity’.
Management	Injection of daily insulin. Lifestyle management including control of diet and physical activity.	Lifestyle management including control of diet and physical activity. Oral medication and insulin therapy when required.
Notes	A potentially volatile condition, in which people can rapidly become critically ill due to either hypoglycaemia (low blood sugar) or hyperglycaemia (high blood sugar). Early onset leads to long-term complications. The focus of management is to gain consistent control over blood sugar levels in order to delay the onset and severity of complications in later life.	The nature of T2D is less volatile than T1D, and in many cases may deteriorate silently and undiagnosed for many years. As a result diagnosis is often made once complications are evident.

The on-going sedentary nature and poor dietary habits of the modern world has led to an increase in the prevalence of Type 2 diabetes in recent years, and disappointingly, the onset of Type 2 diabetes in children and adolescents (Reinehr, Kiess, Kapellen, Wiegand, & Holl, 2010; World Health Organisation, 2010a). Due to the strong link with lifestyle, Type 2 diabetes is the main focus of this PhD research.

1.2.2 Why is Type 2 diabetes a global health concern?

Diabetes is a complex condition, interweaving many factors, each of which will be discussed in turn below.

a) Rising Prevalence: The global prevalence of diabetes in adults is currently estimated at 285 million people (6.4%), of which 90% represents Type 2 diabetes. It is estimated this number will reach over 430 million (7.7%) by the year 2030 (Shaw, Sicree & Zimmet, 2010). Worryingly, the incidence of Type 2 diabetes in children and adolescents also continues to rise (Pinhas-Hamiel & Zeitler, 2005; Reinehr et al., 2010). In 1990, 3% of newly diagnosed cases of Type 2 diabetes in the USA were children and adolescents. This rose to 45% by 2005 (Pinhas-Hamiel & Zeitler, 2005). The World Health Organisation (WHO) predicts diabetes-related deaths will double between 2005 and 2030. In 2008 alone, diabetes was related to 1.3 million deaths (World Health Organisation, 2010b), of which over 80% occurred in low and middle income countries. Of particular note, Scotland - where this PhD research has been conducted - has a high prevalence of diabetes, estimated at 4.7% of the population (n=247,278). Type 2 diabetes represents 88% (217,514) of this figure and continues to increase at a rate of 4% per year (Scottish Diabetes Survey Monitoring Group, 2012).

b) Demographics: Despite Type 2 diabetes being a global problem, its incidence is not spread equally throughout the population. Several groups are at a higher risk of developing Type 2 diabetes, creating a significant health inequality throughout society. Low socioeconomic groups and people of specific ethnic origin (including South East Asian, African-Caribbean, black African and Australian Aborigines) are classed as higher risk groups (National Institute for Clinical Excellence, 2011a). While social and cultural differences play a role in ethnic inequality, a genetic predisposition is also thought to be a contributing factor (Abate & Chandalia, 2001; Greenhalgh, 1997). Significant inequality also exists between countries, with levels of diabetes in 2030 estimated to have increased by 69% in developing countries, compared with 20% for developed countries. A proposed explanation is the increase in sedentary activity caused by rapid urbanisation of developing countries (Shaw et al., 2010).

c) Obesity: Type 2 diabetes has a strong positive relationship with overweight and obesity. In addition to an association with Type 2 diabetes, overweight and obesity also leads to other health problems, including raised blood pressure, cholesterol, triglycerides and insulin resistance. Overweight and obesity also increases the risk of many conditions such as coronary heart disease, ischaemic stroke and various cancers. It is therefore evident that the on-going increase in obesity not only translates to an increase in Type 2 diabetes, but also many other health related problems affecting global health. In particular, the deaths of 2.8 million people per year are attributed to overweight and obesity (World Health Organisation, 2010b).

d) Ageing population: Between 1960 and 2000, life expectancy in Europe increased by 8 years, with a further rise of 5.5 years estimated by 2050. The projected life expectancy of people living in European Union countries by the year 2050 will reach approximately 86 years (Carone, Costello, Diez Guardia, Eckefeldt & Mourre, 2008). People with Type 2 diabetes will therefore live longer. This will be reflected in a greater number of people developing diabetes complications (outlined below). Due to Type 2 diabetes typically being of adult-onset (Table 1.1) a longer life expectancy will also result in a greater number of people being diagnosed.

e) Complications: Long-term complications associated with diabetes play a significant role in the severity of the public health problem. As mentioned, the nature of diabetes is a chronic, deteriorating condition which causes damage to the nervous system and circulatory system. It therefore has the potential to cause long-term damage to any area of the body. In particular, several areas of the body are highly susceptible to diabetes-related complications, including the eyes, cardiovascular system, renal system and peripheral nervous system (outlined in Table 1.2). The impact of diabetes-related complications on an individual’s wellbeing, quality of life and life expectancy cannot be underestimated: a 60-year old male with diabetic complications may lose 8-10 years of life without adequate treatment (The National Collaborating Centre for Chronic Conditions, 2008).

f) Economic burden: The identification and management of diabetes has a significant impact on the economy of health care systems. It is estimated that 12.6% and 10.8% of the UK's health care costs are spent on diabetes inpatient and outpatient care respectively (Morgan et al., 2010). NHS Scotland spent £301 million on diabetes inpatient care alone in 2011 (Scottish Diabetes Survey Monitoring Group, 2012). In addition to treatment costs, economies are also affected by the loss of people in employment. The WHO provide an example for China, where for the period 2006-2015, the country will forfeit US$558 billion of national income due to diabetes, stroke and heart disease (World Health Organisation, 2010b).

This brief synopsis clearly shows the impact of diabetes on global health. Many contributing factors have been highlighted including: an increasing prevalence of Type 2 diabetes, obesity and obesity-related conditions; an ageing population; earlier onset and diagnosis in children and young adults; on-going long-term complications affecting both physical and mental wellbeing; and a large economic burden on health care systems.

Table 1.2. Complications associated with diabetes (adapted from World Health Organisation, 2011)

Complication	
Diabetic Retinopathy	A result of long-term accumulation of damage to small blood vessels in the retina. An estimated 10% of people develop severe visual impairment, and 2% blindness, 15-years after diagnosis.
Cardiovascular disease	Increased risk of stroke and heart disease. 50% of people with diabetes die from cardiovascular disease.
Kidney Failure	Diabetes is the leading case of kidney failure. 10-20% of people die from kidney failure.
Diabetic Neuropathy	Damage to the nerves as a result of diabetes. Affects up to 50% of people with diabetes. Leads to tingling, pain, numbness or weakness in the hands and feet.
Peripheral Neuropathy	Associated with reduced blood flow to the limbs and increases the risk of foot ulcers and limb amputation.
Mortality	People with diabetes have a double-fold risk of dying prematurely compared to peers without diabetes.

1.3 Physical Activity

1.3.1 What is physical activity?

Physical activity is defined as any movement of the body resulting in increased energy expenditure above resting levels (Center for Disease Control and Prevention, 2011). Different activities result in different energy expenditures, therefore, a general expression of an activity's intensity level is commonly demonstrated using the term METs (Metabolic Equivalents), where 1-MET is the equivalent of resting (i.e. sitting quietly) (World Health Organisation, 2012). Various terms are used to define and describe the various intensity levels at which physical activity can be undertaken. These include light physical activity (LPA) at 1-3METs (e.g. slow walking and standing), moderate physical activity (MPA) at 3-6METs (e.g. gardening and brisk walking) and vigorous physical activity (VPA) at greater than 6METs (e.g. running and boxing) (World Health Organisation, 2012).

1.3.2 What is sedentary behaviour?

Sedentary behaviour is defined as low energy expenditure of less than 1.5METs in a sitting or reclining position (Sedentary Behaviour Research Network, 2012). This is different to the term *inactive* which is typically used to describe individuals who do not meet the current physical activity recommendations (Sedentary Behaviour Research Network, 2012). As proposed by Owen et al (2010, p. 105) - "*Too much sitting* is distinct from *too little exercise*". Research has demonstrated that an average 7-10 waking hours per day is spent sitting or lying down (Owen et al., 2010). Prolonged sedentary time, such as extended periods of sitting, leads to poorer health outcomes, even in individuals who undertake physical activity throughout the day (Healy, Dunstan, Salmon, Cerin, et al., 2008).

Evidence suggests that a pattern of prolonged sedentary behaviour, with limited breaks in sitting or lying time, is detrimentally associated with health outcomes (Healy, Matthews, Dunstan, Winkler, & Owen, 2011). Sedentary behaviour leads to adverse changes in cardiometabolic health including suppression of triglyceride uptake, glucose uptake and HDL cholesterol production (Hamilton, Healy, Dunstan, Zderic, & Owen, 2008). These physiological changes play an important role in the development of diabetes. The Australian Diabetes, Obesity and Lifestyle Study demonstrated that undiagnosed abnormal glucose metabolism and metabolic syndrome were positively associated with TV viewing time. As TV viewing time increased over a 5-year period participants demonstrated further adverse changes including increased waist circumference and diastolic blood pressure (Healy, Dunstan, Salmon, & et al, 2008; Healy, Wijndaele, Dunstan, & et al, 2008) .

In the general population less than 5% of waking hours is spent in MPA, with the remaining hours of the day predominantly spent in sedentary behaviour. Studies have identified that variations in sedentary behaviour are mainly due to LPA rather than MPA, highlighting the importance of continued research to understand the role and impact of LPA and sedentary behaviour on health (Thompson & Batterham, 2013).

1.3.3 Why is physical activity important?

The role of physical inactivity for global health is significant. In 2010 physical inactivity was ranked as the fourth leading risk factor of mortality, and was related to an estimated 3.2 million deaths per year (World Health Organisation, 2010b).

Controlling the economic and social burden of lifestyle-related chronic disease has recently been established as a global priority of the United Nations (United Nations General Assembly, 2011). Low physical activity levels and sedentary behaviour are linked to the cause and deterioration of many health conditions including: stroke, high blood pressure (hypertension), depression, ischaemic heart disease, cancer, and of course Type 2 diabetes (Allender, Foster, Scarborough, & Rayner, 2007; Tremblay, Colley, Saunders, Healy, & Owen, 2010). Physical activity is also the key to appropriate energy balance in the prevention of overweight and obesity, which plays a significant factor in the current poor global health record. Individuals can reduce their risk of certain cancers by 21-25%, Type 2 diabetes by 27% and ischaemic heart disease by 30% by participating in regular physical activity (World Health Organisation, 2010b).

1.3.4 Physical Activity Guidelines

Due to the significance of physical activity on global health, many leading organisations from a range of countries have published guidelines for achieving sufficient physical activity to gain health benefits. Recommendations are based on an extensive evidence-base of research studies conducted worldwide. Guidelines are published on physical activity for the general adult population (19-64 years), and other sub groups of the population including: early years (under 5s); children and young people (5-18 years) and older adults (65+ years). In addition specific guidance has been published for people with Type 2 diabetes.

1.3.4.1 Physical activity guidelines for the general adult population and older adults

Physical activity recommendations for the general adult population are widely used, and include the WHO's *Global Recommendations on Physical Activity for Health* (2010a), and the current UK *Physical Activity Guidelines for Adults: 19-64 years* (Department of Health, 2011). In summary, these recommendations include:

- at least 150 minutes of MPA per week, which can be accumulated in minimum bouts of 10 minutes
- or 75 minutes of VPA
- or an equivalent combination of MPA and VPA
- at least 2 sessions per week of muscle strengthening resistance activity
- a reduction in the amount of time spent in extended periods of sedentary behaviour.

Older adults (65+ years) are encouraged to achieve the recommendations above to improve health benefits and cognitive function. In addition to the general recommendations older adults are also encouraged to perform activities to improve balance and coordination on at least 2 days per week. This type of activity aims to reduce the risk of falls and the subsequent risk of bone fracture (Department of Health, 2011b).

In addition to the many guidelines operating globally, the recent *Toronto Charter for Physical Activity: A Global Call for Action* (Global Advocacy Council for Physical Activity, 2010) has highlighted the need for international, national and local organisations to work together to effectively achieve these recommendations.

1.3.4.2 Physical activity guidelines for people with Type 2 diabetes

Current guidelines addressing physical activity for people with Type 2 diabetes have been published by many leading organisations, including the *Scottish Intercollegiate Guidelines Network* (2010), *International Diabetes Federation* (2005), *and the American College of Sports Medicine* in conjunction with the *American Diabetes Association* (Colberg et al., 2010). The guidelines present a consistent message, and share the same recommendations as those for the general adult and older adult population. However, all guidelines state that durations of physical activity greater than the *minimum recommendation* will provide additional health benefits. More recently, the Position Statement from the *Exercise and Sport Science Australia* (Matthew et al., 2012), recommends a greater *minimum* duration of physical activity for people with Type 2 diabetes, with the performance of:

- at least 210 minutes of MPA per week, or 125 minutes of VPA
- at least two resistance training sessions per week (2-4 sets of 8-10 reps)
- with no more than two consecutive days between activities.

This greater minimum duration of physical activity is linked with improved glycaemic control (Matthew et al., 2012). It is known that severity of Type 2 diabetes and its consequent complications are closely related to glycaemic control via mechanisms such as increased insulin sensitivity and glucose uptake (discussed in greater detail below, page 14) (Colberg et al., 2010). Therefore guidelines for Type 2 diabetes recommend greater bouts of physical activity to provide a cumulative effect on physiological processes which improve glycaemic control.

In addition, published recommendations for people with Type 2 diabetes also give guidance on:

- behaviour change skills
- advice regarding blood glucose control and the avoidance of hypoglycaemia in people taking insulin
- medical review for people with existing diabetes-related complications
- and tailored physical activity interventions based on a valid theoretical framework (discussed in Chapter 2: Literature Review).

1.3.4.3 Who meets these guidelines?

Research for this thesis was undertaken in Scotland, where the high prevalence of Type 2 diabetes has already been noted. According to the national health promotion strategy, 'Let's Make Scotland More Active', physical inactivity is a health risk for 65.5% of the population (Scottish Government, 2003). Little change has occurred in physical activity levels since then, with 2011 figures showing 61.0% of the population not achieving the recommended levels (Scottish Government, 2011). These high levels of physical inactivity have great potential to contribute to the high prevalence of Type 2 diabetes in Scotland.

In addition to the majority of the general population not meeting the current guidelines, it is also known that people living with diabetes have significantly lower levels of physical activity. In studies of the US population, 42% of the non-diabetes population did not meet the standard physical activity guidelines for the general population, compared with a higher proportion of 61% of adults with diabetes (Morrato et al., 2007). Low levels of physical activity in people with Type 2 diabetes are further documented by Canadian data where 71.9% of adults with Type 2 diabetes did not meet the physical guidelines (Plotnikoff et al., 2006). These data are consistent with a recent intervention study by Plotnikoff and colleagues (2012), where 65% of adults with Type 2 diabetes were not meeting physical activity recommendations at baseline.

1.4 The relationship between Type 2 diabetes and physical activity

It is well known that physical activity is crucial in the effective management of diabetes. Extensive research has built a large and strong evidence base for the role of physical activity on diabetes management, with physical activity being described as the 'cornerstone' of effective diabetes management (Colberg & Grieco, 2009; Yates, Khunti, Troughton, & Davies, 2009).

It is not within the scope of this thesis to extensively explore the physiological effects of physical activity on Type 2 diabetes; however, it is important to at least highlight *why* physical activity is considered one of the cornerstones of diabetes care.

Several studies have undertaken large scale synthesis and comparison of the data and published concise findings on the overall effect of physical activity on Type 2 diabetes. Three publications of note include:

- a systematic review by Thomas et al (2006) which undertook one of the first meta-analyses comparing the effects of exercise in people with Type 2 diabetes. This included the analysis of fourteen randomised controlled trials, comparing exercise with no exercise in samples of adults with Type 2 diabetes (n=377).
- a Joint Position Statement by the American College of Sports Medicine (ACSM) and the American Diabetes Association (ADA), which provided an in-depth graded analysis of the evidence surrounding exercise and diabetes (Colberg et al., 2010).
- a recent systematic review by Chudyk and Petrella (2011) exploring the effect of exercise on cardiovascular risk factors in people with Type 2 diabetes. This

included an analysis of 34 interventions measuring cardiovascular outcomes including: blood glucose control, blood lipids, blood pressure and body composition.

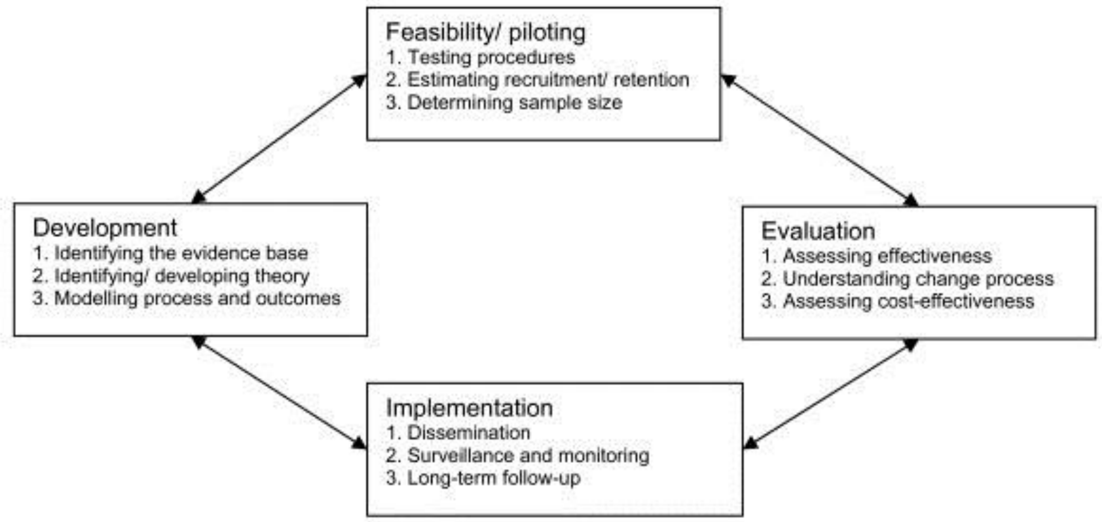
These systematic reviews have concluded that physical activity can significantly improve glycaemic control and diabetes-related complications. Moderate increases in physical activity have been shown to reduce HbA1c, and improve insulin sensitivity, fat oxidation and lipid storage in muscle. Many other positive physiological responses have been identified by increasing physical activity levels. These include: an increase in glucose uptake into active muscles, hepatic glucose production, increased skeletal muscle mass, improved fat oxidation and systemic insulin action. Additional responses include a reduction in low-density lipid cholesterol; systolic blood pressure; and risk of cardiovascular mortality. These changes also contribute to a reduced risk of depression and improved health related quality of life (Chudyk & Petrella, 2011; Coldberg et al., 2010; Thomas et al., 2006).

It is clear from these findings why physical activity is considered a cornerstone of diabetes care. Incorporating physical activity into daily life can have significant benefits on an individual's disease management. It is therefore essential that physical activity programmes are developed and implemented into everyday clinical practice for patients who could benefit.

1.5 The Medical Research Council Framework

The Medical Research Council's framework for the development and evaluation of health interventions describes the importance of identifying the 'active ingredients' of an intervention (Medical Research Council, 2000, 2008). A wide range of components interact to produce unique environments in which to implement interventions and similar results are not guaranteed by simply replicating a study protocol. The Medical Research Council therefore presents a framework to guide the development, evaluation and implementation of health interventions from the initial exploratory stages of research to the latter stages of long-term implementation. *Development* of an evidence-based intervention is required followed by a *feasibility* and *piloting* phase to assess the intervention procedures for acceptability in a specific context. The next step is to *evaluate* the intervention for its effectiveness, processes and cost-effectiveness followed by an *implementation* stage aiming to get ‘evidence into practice’. Figure 1.1 outlines the key stages of this complex process and the activities that may be undertaken at each stage.

Figure 1.1. Key elements from the Medical Research Council’s framework for the development, evaluation and implementation of health interventions (Figure from Medical Research Council, 2008)



The Medical Research Council framework provides an initial stepping stone to guide the complex process of translating research findings into everyday practice. This is particularly relevant for this thesis which explores in detail the translation and implementation of physical activity interventions within routine diabetes care. The various stages of the framework are discussed in more detail throughout the thesis.

1.6 Translational Research

1.6.1 What is translational research?

Translation is the application of knowledge from 'theory into practice', also referred to as 'from bench to bedside' (Pagoto, 2011). There is a distinct difference between research findings that support 'theory/bench' (efficacy), when compared with research findings that support 'practice/bedside' (effectiveness). Interventions which demonstrate efficacy typically produce results from a controlled research environment. They tend to be RCT's using strict eligibility criteria and objective outcome measures (Courneya, 2010). In contrast, interventions which demonstrate effectiveness are typically undertaken in a routine care context. They may use research staff or routine health professionals to implement the intervention and participants usually represent everyday practice by having complex support needs (Courneya, 2010). Both efficacy and effectiveness interventions play a critical role in behaviour change research and can be linked via the process of translation.

As noted above, an extensive range of interventions show high efficacy for physical activity interventions in people with Type 2 diabetes. These findings show that in a controlled environment, physical activity interventions can result in positive changes in people with Type 2 diabetes. However, as quoted in the British Medical Journal,

- "The results of thousands of trials are never acted on because their published reports do not describe the interventions in enough detail" (Glasziou et al., 2010, p. 1).

Information is also required on *how* the intervention worked in practice i.e. What challenges were identified with recruitment? How much did the intervention cost? What changes were required to the study protocol? Why did participants not complete the intervention? How was the intervention tailored to the population? Research findings also need to provide *useful* information to facilitate adoption and implementation by health professionals and policy makers (S Biddle & Mutrie, 2008; World Health Organisation, 2000).

The process of translation allows research findings to be applied in various contexts. For example, an intervention for African-American females with Type 2 diabetes in an urban setting may differ significantly in terms of recruitment, facilities, delivery and outcomes when compared with an intervention for Aboriginal Australian males with Type 2 diabetes in a rural setting. Both interventions could be based on the same theory, but translation of the intervention for the specific population and setting is required.

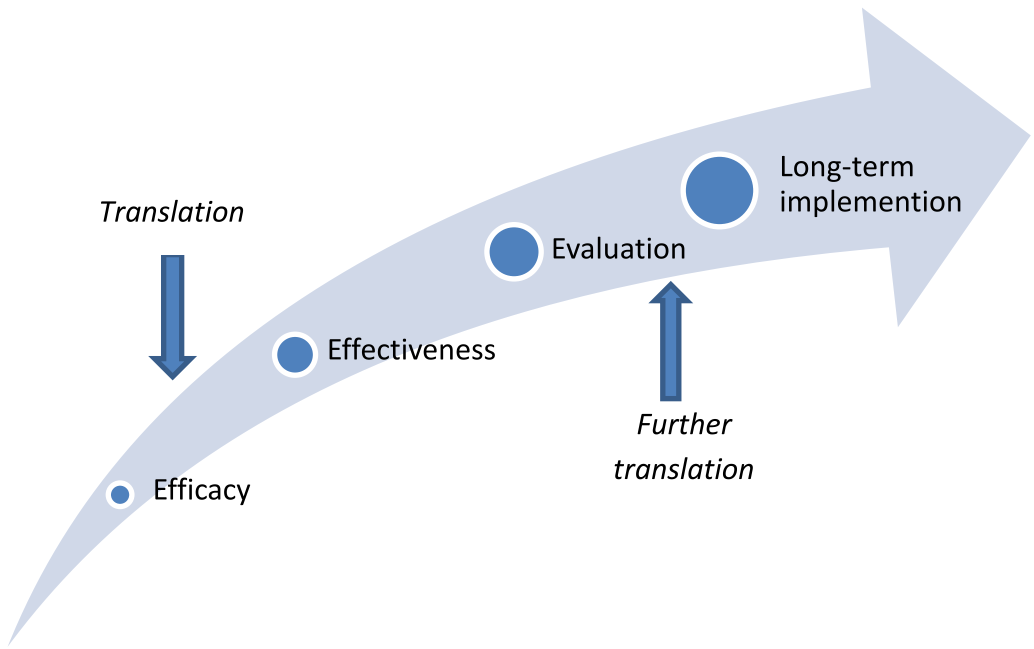
The natural environment of an intervention is associated with everyday variables that cannot be measured in controlled efficacy studies. The range of potential factors present in a natural environment is wide and varied, including: weather, funding, staff knowledge and experience, staff turnover and commitment (including loss of the programme “champion”), venue facilities, public transport, and time constraints (Lattimore et al., 2010; Rosal & al, 2011; Schneider, Sullivan, & Pagoto, 2011). Translation of an intervention for implementation needs to address these factors. Reducing the potential barriers and challenges prior to implementation will promote success and sustainability of the intervention.

1.6.2 Processes of Translation

The goal of health intervention research is the *adoption* of new sustainable evidence-based practices by health care providers, delivering new interventions to individuals and populations who will benefit. Translation of research findings plays a key role in the adoption of new clinical practice, as outlined in Figure 1.2. The findings from robust efficacy studies require translation into practice, where methods and findings are studied for effectiveness in various contexts. Evaluation of translated interventions then allows for interventions to be improved via further translation, leading to the adoption of new and improved interventions for widespread implementation (Figure 1.2).

Dougherty and Conway (2008) present a three stage process of translation. Stage one (T1) represents the initial translation of a new research finding into its first evaluation with human participants. Stage two (T2) occurs when findings are incorporated into everyday clinical practice. A final stage three (T3) involves the generalisation of research findings to the wider population, where interventions reach those people whose health will ultimately benefit from the initial research finding.

Figure 1.2. The process of long-term implementation (Created by Matthews using text from Dougherty and Conway (2008) and Abernethy and Wheeler (2011)



The application of research findings into clinical practice can be impeded at any one of these translational stages (T1-T3). Abernethy and Wheeler (2011) refers to these translational obstacles as *blocks* and describes the role they play in preventing translational medicine delivering on its 'vast potential'.

1.6.3 Tools for Translational Research

Adoption by health care providers is not the end point for new evidence-based health interventions. Unfortunately adoption of new health interventions does not guarantee long-term success. Sustainability remains a great challenge, affected by the ever changing nature of health care departments, funding and staff (Pagoto, 2011). Therefore on-going evaluation and translation plays a key role in promoting sustainable health intervention programmes.

It is clear that translation of research findings is a long, complex and on-going process, which may continue long after health services have adopted a new intervention programme. The importance of translational research has been highlighted more recently, and consequently, several translational tools are available to assist researchers and clinicians undertake the process effectively.

Two such translational tools, which share similar characteristics, were utilised throughout the duration of this PhD and are introduced briefly below: (1) Process Evaluation and (2) the RE-AIM Framework.

1.6.3.1 Process Evaluation

Sustaining effective health interventions requires methods of identifying the various components of an intervention which are effective and under what circumstances. Process evaluations are one such method. Process evaluation has been in effect since 1967 (Steckler & Linnan, 2002), however, it is not until more recently that this method of translation has been used more frequently in health intervention research.

The WHO (2000) recommends the use of process evaluations in health intervention research to address three issues:

1. Programme development and improvement
2. Accountability to stakeholders

3. To help others set up similar services.

Bliss and Emshoff (2002) also support the use of process evaluation in their published framework. They identify the role of process evaluation as exploring three key questions:

1. What is the programme intended to be?
2. What is delivered, in reality?
3. Where are the gaps between programme design and delivery?

An overview of the key components required for a process evaluation is outlined in Table 1.3.

Table 1.3. Components of a process evaluation (Created by text from Linnan & Stickler 2002, Baranowski & Stables 2000)

Component	**Component Definition**
Context	Aspects of the environment that may influence intervention implementation, including: cultural, economic, political.
Reach	The extent to which the programme is delivered to the target group.
Dose delivered	The number or amount of intended units of each intervention component provided.
Dose received	The extent to which participants actively engage with, interact with, are receptive to, and/or use materials or recommended resources.
Fidelity	The extent to which the intervention was delivered as planned.
Implementation	Issues relating to the delivery of the planned intervention.
Recruitment	Procedures used to approach and attract participants, including: individual, organisational or community level.

Resources	The materials or characteristics of agencies, implementers, or participants necessary to achieve project goals.
Contamination	The extent to which participants receive interventions from outside the programme.
Maintenance	The extent to which participants remain involved in the programme, and sustain any outcomes long-term.

The use of process evaluations in the translation of research findings for effective clinical practice is increasing. However, a lack of a systematic approach in reporting of the evaluation findings remains an issue (Steckler & Linnan, 2002). Adherence to guidelines set out by organisations such as the WHO (2000) can help ensure publications report both reliable and *useful* data for fellow researchers and clinicians.

1.6.3.2 The RE-AIM Framework

Another useful tool in the process of translation is the widely used RE-AIM framework. Developed by Glasgow, Boles and Vogt (1999), the framework originally aimed to facilitate the dissemination and implementation of evidence based behavioural interventions. Over time, the framework has since become a guide for translating research findings into everyday practice (Oldenburg & Absetz, 2011). RE-AIM is frequently used to guide and evaluate the translation of research into practice by promoting the development of interventions based on elements of Reach, Effectiveness, Adoption, Implementation and Maintenance (outlined in Table 1.4).

The framework is freely available online (http://www.re-aim.org) and is supported by additional translational tools and resources (Dzewaltowski, Glasgow, Klesges, Estabrooks, & Brock, 2004). In particular, RE-AIM addresses the *block* in stages T2-T3 of the translation process, where findings from interventions delivered in everyday practice settings are translated and generalised to the wider population (Abernethy & Wheeler, 2011).

Table 1.4. Components of the RE-AIM framework (Glasgow et al, 1999)

Component	Definition
Reach	What percentage of potentially eligible participants (a) were excluded, (b) took part, and (c) how representative were they?
Effectiveness	What impact did the intervention have on (a) all participants who began the program, (b) on process intermediate and primary outcomes, and (c) on both positive and negative (unintended), outcomes including quality of life?
Adoption	What percentage of settings and intervention agents within these settings (e.g., schools/educators, medical offices/physicians) (a) were excluded, (b) participated, and (c) how representative were they?
Implementation	To what extent were the various intervention components delivered as intended (in the protocol), especially when conducted by different (non-research) staff members in applied settings?
Maintenance	
- Setting	The extent to which a programme or policy becomes institutionalised or part of the routine organisational practices and policies.
- Individual	The long-term effects of a programme on outcomes after 6 or more months after the most recent intervention contact.

1.7 Summary

Physical activity plays an essential role in the routine management of people with Type 2 diabetes, but despite its importance it remains under-utilised. Extensive research continues to be undertaken looking at the various components of physical activity interventions, including: barriers and motivators of participation, effective methods of intervention delivery, and issues related to long-term maintenance of behaviour change. However, few studies have been translated into effective behaviour change programmes for people with Type 2 diabetes in everyday practice (to be discussed in Chapter 2 and Chapter 3). This goal can be achieved by using published guidelines addressing issues of translation, i.e. the Medical Research Council framework, the RE-AIM Framework and/or Process Evaluation.

This introduction has provided the initial background to the thesis by introducing Type 2 diabetes, physical activity, and translational research. Chapter 2 aims to present a detailed discussion of published research relevant to this field of research. Chapter 2 also highlights the research gaps and provides a detailed overview of the research questions addressed by this PhD.

CHAPTER 2

Literature Review

2.1 Overview

Research findings from controlled efficacy studies have shown that sufficient physical activity results in significant health benefits for people with Type 2 diabetes (Colberg et al., 2010; Thomas et al., 2006). Physical activity, performed at a moderate intensity for a minimum of 150 minutes per week improves glycaemic control and reduces the incidence of complications (Colberg et al., 2010; Sigal, Kenny, Wasserman, Castaneda-Sceppa, & White, 2006). However, the majority of people with Type 2 diabetes have low levels of physical activity and require support to change their behaviour (Morrato et al., 2007; Plotnikoff et al., 2012).

The following review of literature aims to present the extensive research that has been conducted on physical activity behaviour change in people with Type 2 diabetes. The chapter begins with a description of the barriers and motivators associated with physical activity behaviour change in both the general population and adults with Type 2 diabetes, followed by an overview of theoretical models of behaviour change. The main body of the literature review then presents a discussion of the current evidence base for physical activity interventions and the management of Type 2 diabetes. This section is structured by the five main intervention methods used by the current literature. A brief outline of the progress of diabetes *prevention* research is then provided. The purpose of this summary is to demonstrate the 'success' of translational research in the field of diabetes prevention. This sets a benchmark for which researchers and practitioners in the field of diabetes *management* should work towards. A summary of the research gaps, and how this PhD addresses them, is provided at the end of the chapter.

2.2 Barriers and facilitators of physical activity

Various barriers and facilitators influence an individual's decision to participate in physical activity. While people with Type 2 diabetes experience similar barriers as the general population, they also experience several disease-specific barriers to physical activity (Table 2.1). Understanding the circumstances of people with Type 2 diabetes is essential for the development of appropriate physical activity interventions.

Table 2.1. Barriers and motivators to physical activity (Biddle & Mutrie, 2008; Casey, De Civita, & Dasgupta, 2010; Cerin, Leslie, Sugiyama, & Owen, 2010; Huebschmann et al., 2011; Morrato et al., 2007)

	Barriers	**Facilitators**
General Population	Lack of time	Health benefits
	Low motivation	Weight control
	Cost of activity	Improved fitness
	Poor weather	Stress release
	No enjoyment	
	Shyness, embarrassment	
	Lack of support & knowledge	
	Lack of available facilities	
	Need for relaxation in spare time	
Diabetes Population	Fear of injury	Avoid complications
	Fear of low blood sugar	Reduce medications
	Obesity	Weight control
	Embarrassment and/or shame	Peer support and encouragement
	Depression	
	Absence of supervision	
	Lack of support	
	Cultural expectations	
	Attitude of defeat	

2.2.1 General Population

Barriers to physical activity have been well researched and documented (Cerin et al., 2010; Health Scotland, 2004; Sports Council and Health Education Authority, 1992). The most commonly reported factor is lack of time, typically associated with work and family commitments. Other major barriers include a lack of motivation, available facilities, energy, experience and appropriate attire. Furthermore, a lack of confidence in an individuals' ability to perform physical activity may be associated with poor health, injury, older age and lack of physical activity experience. Additional contributing factors include the cost of initiating physical activity, poor weather, and an individual's need for relaxation in their spare time (Biddle & Mutrie, 2008; Cerin et al., 2010).

Motivating factors, known as *facilitators*, also contribute to the initiation and maintenance of regular physical activity within the general population. The most commonly reported facilitators include greater health benefits, improvements in levels of fitness, reduction in levels of stress, and successful weight control (Biddle & Mutrie, 2008; Cerin et al., 2010).

2.2.2 Type 2 Diabetes

As discussed in Chapter 1, many people with Type 2 diabetes develop diabetes-related complications (Chapter 1, Table 1.1). People experience a reduced capacity in their physical functioning, often due to pain, limited bodily movement and lethargy (Casey et al., 2010). Furthermore, obesity in people with Type 2 diabetes reduces bodily movement, and contributes to feelings of embarrassment and shame (Morrato et al., 2007). Depression is also associated with Type 2 diabetes, negatively effecting levels of motivation, energy and self-worth (Andersen, Freedland, Clouse, & Lustman, 2001). Their fear of injury is greater when compared with the general population, and they often report feelings of defeat due to the deteriorating nature of their condition (Huebschmann et al., 2011). These multiple barriers indicate that people with Type 2 diabetes require adequate support to change their physical activity behaviour; however, this support is often lacking (Casey et al., 2010).

A study by Plotnikoff et al (2009) compared the pros and cons for physical activity in individuals with and without diabetes (Type 1 or Type 2 diabetes). Findings demonstrated that people with diabetes reported significantly lower scores for pros, and higher scores for cons, than people without diabetes. Specific cons included a lack of social support and fear of hypoglycaemia. These findings support the main barriers presented in Table 2.1, where barriers specific to Type 2 diabetes include pain, injury, negative side effects and availability of support.

Cultural barriers are present in people with Type 2 diabetes from certain ethnic groups. In particular, the UK has a high prevalence of residents of South Asian origin (India and Pakistan), in which the prevalence of Type 2 diabetes is 4 times greater than the general population (Lawton, Ahmad, Hanna, Douglas, & Hallowell, 2006). Specific barriers within this group include complex issues related to family. Physical activity is considered a selfish use of time, which could otherwise be spent supporting family with work, child-care or household chores. Other barriers included the lack of culturally appropriate physical activity facilities, difficulty of undertaking physical activity in cultural attire, and feelings of vulnerability (associated with use of the English language and unfamiliarity of local neighbourhoods) (Lawton et al., 2006).

It is equally important to consider motivating facilitators for physical activity in people with Type 2 diabetes, which include: greater control of blood sugar levels, reduced levels of medication, avoidance of complications, weight control, and social support from peers with Type 2 diabetes (Korkiakangas, Alahuhta, & Laitinen, 2009). Further research by Korkiangas et al (2011) for people identified at high risk of Type 2 diabetes, identified additional motivators which may be relevant for individuals already diagnosed with Type 2 diabetes. These included gaining enjoyment from an active lifestyle, a desire to accompany people who lived an active lifestyle, and the opportunity to present positive examples to their children.

While barriers and facilitators contribute significantly to an individual's decision to be physically active, they are not the only factors involved. Theoretical models of behaviour change exist to help explain the relationship between the many factors of physical activity behaviour change.

2.3 Models of Behaviour Change

Initiation and maintenance of a physically active lifestyle is a complex and challenging issue. Social, cultural, environmental, economic and psychological factors play a role in an individual's decision to participate in physical activity. Many theoretical models attempt to explain the interaction between these factors, including: the Health Belief Model (Rosenstock, 1974), Social Cognitive Theory (Bandura, 1989), Self-Efficacy Theory (Bandura, 1977), the Theory of Planned Behaviour (Ajzen, 1991), and the Transtheoretical Model of Change (Prochaska & Velicer, 1997). Many of these models are based on psychological constructs, with some also including environmental and/or social variables (Biddle & Mutrie, 2008).

Despite the clear benefits of physical activity, people with Type 2 diabetes have low levels of participation. Theoretical models which help to explain the complex process of behaviour change therefore have the potential to aid development of appropriate physical activity interventions for this population.

The literature available on theoretical models of behaviour change is extensive (Greaves et al., 2011; Michie et al., 2011) and it is beyond the scope of this thesis to review this comprehensively. The application and investigation of these models, however, in people with Type 2 diabetes is limited. Despite the range of theoretical frameworks available a search of the literature identified two models of behaviour change as being frequently used to *understand* the behaviour change processes of the diabetes population: (1) the Theory of Planned Behaviour and (2) the Transtheoretical Model of Change. An overview is therefore provided for both of these models of behaviour change.

2.3.1 Theory of Planned Behaviour

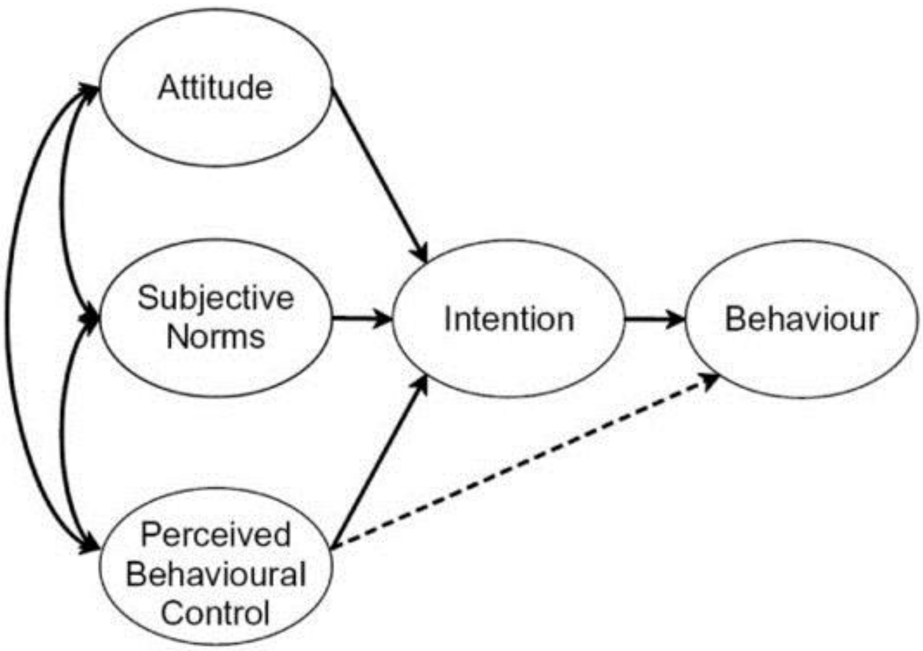
The Theory of Planned Behaviour (TPB) (Ajzen, 1991) has been widely used in health behaviour research to explore the complexities of behaviour change, including physical activity participation (Hagger, Chatzisarantis, & Biddle, 2002; Hobbs, Dixon, Johnston, & Howie, 2012). The model suggests that the adoption of new behaviour involves the interaction of several determinants (see Figure 2.1), including:

(1) Attitude: an individual's perception of the benefits and drawbacks of adopting a physical activity.

(2) Subjective norm: an individual’s perceived expectations of family, friends and peers in relation to their new physical activity behaviour.

(3) Perceived behavioural control: an individual’s perception of their control regarding opportunities, resources and obstacles to new physical activity behaviour.

Figure 2.1. The Theory of Planned Behaviour (Ajzen, 1991) (Figure from Luzzi and Spencer, 2008)



Attitude, subjective norm and perceived behavioural control interact to influence an individual's *intention* to perform physical activity and are considered a reflection of an individual's motivation for change. The TPB has therefore been explored as a tool for understanding the intentions and behaviour of individuals with Type 2 diabetes.

Mixed findings have been reported in those studies of the diabetes population. The UK ProActive trial explored whether the TPB could be used to predict physical activity levels and change in physical activity in a sample of adults at high-risk of developing Type 2 diabetes (n=365) (Hardeman, Kinmonth, & Michie, 2011). Participants completed a 46-item TPB questionnaire, in addition to physical activity outcomes in the form of heart rate monitoring and self-report physical activity questionnaires at baseline, 6-months and 12-months. Physical activity increased by approximately 20-minutes per day from baseline to 12-months. Results showed that the TPB did not predict physical activity levels or change in physical activity levels over a 12-month period. The ProActive trial involved adults at high risk of Type 2 diabetes, and their mediators for physical activity may differ from individuals who are already diagnosed with Type 2 diabetes. This supports the ProActive authors suggestion that the application of the TPB in clinical populations is more complex than the general population and warrants further research.

Other studies report findings in support of the TPB for physical activity behaviour in the diabetes population. Research by Plotnikoff et al (2010), Boudreau and Godin (2009), and White et al (2012) on individuals with Type 2 diabetes found that 39-60% of their intention to participate in physical activity was associated with attitude, subjective norm, and perceived behavioural control. Further analysis suggested that addressing specific factors related to each component could support individuals in the transition from *intention* to *behaviour*. For example, an RCT (n=183) by White et al delivered a 4-week diet and physical activity intervention where participants in the intervention group received weekly 2-hour group-based education sessions. Content was driven by constructs of the TPB including attitudes and beliefs (*attitude)*, social support *(subjective norm)*, planning and self-efficacy *(perceived behavioural control)*. Following analysis of TPB and physical activity measures at 1-week and 6-weeks post-intervention a significant change was demonstrated in physical activity behaviour in the short-term (1-week post-intervention) but not at 6-week follow-up. Although associations were found for behaviour, intention, planning, perceived behavioural control and subjective norm, analysis suggested that the effect of the intervention was mediated by *planning.* Integrating planning strategies into physical activity interventions for adults with Type 2 diabetes may be a key factor in supporting behaviour change.

In general, collated findings from TPB-based interventions in the diabetes population propose that interventions can promote an individual's intention to undertake physical activity by reflecting the constructs of attitude, subjective norm, and perceived behavioural control using the following methods (Boudreau & Godin, 2009; Plotnikoff, Lippke, Courneya, et al., 2010; White et al., 2012):

- *Attitude*
    - Promoting the benefits of physical activity participation on health.
- *Subjective norm*
    - Gaining support from family and friends.
- *Perceived behavioural control*
    - Encouraging personal responsibility for physical activity.
    - Planning activities in advance and setting achievable goals.
    - Providing information and resources on physical activity options, and local opportunities.
    - Teaching problem-solving skills to overcome perceived barriers.

2.3.2 Transtheoretical Model of Behaviour Change

The Transtheoretical Model of behaviour change (TTM) is a popular theoretical framework used to explain the multi-stage process of health behaviour change (Prochaska & Velicer, 1997). A large volume of research supports the use of the TTM in physical activity behaviour change for the general population (Marshall & Biddle, 2001), with a growing evidence base for its use in adults with Type 2 diabetes (Jackson, Asimakopoulou, & Scammell, 2007; Kim, Hwang, & Yoo, 2004; Kirk, Barnett, & Mutrie, 2007; Kirk, MacMillan, & Webster, 2010; Plotnikoff, Lippke, Johnson, & Courneya, 2010).

The TTM presents a 5-stage dynamic process through which individuals progress when changing behaviour (see Figure 2.2). At any point in time an individual is represented by a ‘stage of change’ known as: pre-contemplation, contemplation, preparation, action, or maintenance (defined in Table 2.1). Less frequently, a sixth stage, ‘termination’, is included in studies. This term refers to a stage where individuals have no risk of relapse. Since this is rarely achieved in physical activity behaviour, termination is typically not considered in physical activity interventions. Individuals may progress from one stage to another and at any point in the process may *relapse* by one or several stages.

Figure 2.2. The 5-stage process of the Transtheoretical Model of Behaviour Change (Figure adapted from Prochaska and Velicer, 1997)

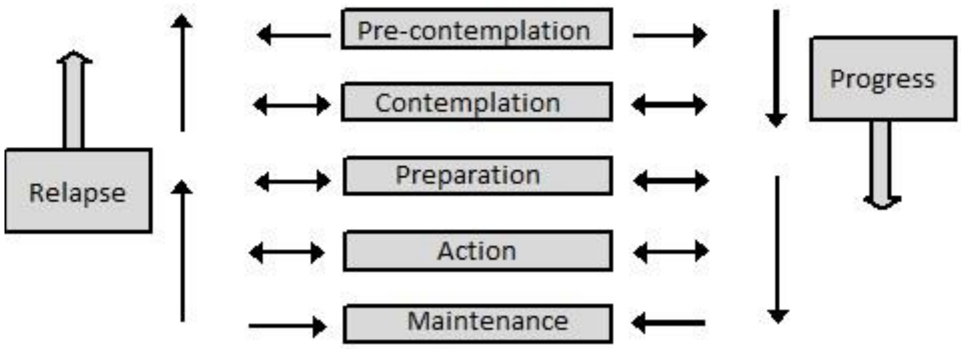


Table 2.2. The Transtheoretical Model's stages of behaviour change (Prochaska & Velicer, 1997)

Stage of Change	**Definition**
Pre-contemplation	Individuals are inactive and do not intend to become active in next 6 months
Contemplation	Individuals are inactive but thinking about becoming active in next 6 months
Preparation	Individuals have made some attempts to become more physically active or expect to become more physically active within the next month.
Action	Individuals are physically active to recommended levels but only in last 6 months
Maintenance	Individuals have been physically active to recommended levels for longer than 6 months
Termination	Individuals have no desire to return to old behaviours and show no risk of relapse
Relapse	Individuals moves backwards to an earlier stage of change

In addition to stages of change, the TTM also involves the interaction of three other factors (Prochaska & Velicer, 1997):

- *Processes of Change:* Ten strategies that individuals use to progress through the stages of change (outlined in Table 2.3). These include *experiential* processes of awareness and evaluation; followed by *behavioural* processes of support, environmental controls, commitments, contingencies and conditioning. Research suggests that experiential processes are more commonly used in the early stages of change, compared with behavioural processes which are more often used in the latter stages of change (Marcus, Rossi, Selby, Niaura, & Abrams, 1992). This suggests that effective behaviour change requires use of a stage-matched process.

- *Decisional Balance:* A reflection of an individual's evaluation of the pros and cons of adopting a new behaviour. The balance between pros and cons differs depending on an individual's stage of change (DiClimente et al., 1991). Research suggests that the cons outweigh the pros of behaviour change during the pre-contemplation stage. The pros begin to increase during the middle stages followed by the pros outweighing the cons of behaviour change during the Action stage (Hall & Rossi, 2008).

- *Self-Efficacy:* An individual's perceived ability to perform a task. This is related to their confidence in performing future tasks. Typically, an individual's self-efficacy increases as they progress through the stages of change.

The TTM operates on the premise that intervention strategies are more effective when matched to a) the appropriate stage of change, and b) the core constructs of processes of change, decisional balance, and self-efficacy. The theory suggests that interventions tailored to stage of change are more effective that non-tailored general methods of physical activity promotion such as information booklets and leaflets. In addition to shaping intervention strategies, the components of the TTM can also be used as an outcome measure in physical activity intervention studies, by assessing participants' stage of change (Kirk et al., 2010).

The dynamic aspect of the TTM represents how an individual's stage of change fluctuates, as influenced by psychological, social and environmental factors. Of the many behaviour change models in operation, the TTM is a favoured choice. An extensive evidence base supports its role in the positive health behaviour change of smoking, sexual behaviour, and physical activity (Arden & Armitage, 2008; Marshall & Biddle, 2001; Robinson & Vail, 2012).

Despite the TTM's popularity, several systematic reviews have found that stage-matched interventions are no more effective than non-stage-matched interventions (Cahill, Lancaster, & Green, 2010; Salmela, Poskiparta, Kasila, Vähäsarja, & Vanhala, 2009; Tuah et al., 2011). However, it is argued that these reviews included analyses of studies that applied the TTM to *stage of change* only, and did not tailor or match interventions appropriately to the additional constructs of *processes of change*, *decisional balance* and *self-efficacy* (Marshall & Biddle, 2001; Prochaska, 2006). There is limited evidence supporting the relationship between all four constructs of the TTM; highlighted in a systematic review by Hutchison et al (2009), which found only 7 of 24 interventions addressed all four constructs of the TTM. Armitage (2009) suggests that the *processes of change* component may play a greater role in behaviour change, yet remains under-researched, especially in the area of physical activity.

The TTM has been explored in people with Type 2 diabetes. Kirk et al (2001) found that participants with Type 2 diabetes receiving an individual TTM-based intervention were more likely to move to an active stage of change compared with a control group receiving standard information.

Table 2.3. The Transtheoretical Model's ten processes of behaviour change (Prochaska & Velicer, 1997)

Process of change	**Definition relating to physical activity**
Experiential	
Consciousness Raising	Increasing awareness about physical activity via information, education, and personal feedback
Dramatic Relief	Feeling fear, anxiety, or worry because of low physical activity levels, or feeling inspiration and hope when they hear about how people are able to change to their physical activity levels
Environmental Re-evaluation	Realising that their lack of physical activity affects others and how they could have more positive effects by changing
Self Re-evaluation	Realising that the physical activity is an important part of who they are and who they want to be
Social Liberation	Realising that society is more supportive of the increasing levels of physical activity
Behavioural	
Counter Conditioning	Substituting healthy ways of acting and thinking for unhealthy ways
Helping Relationships	Finding people who are supportive of their change
Reinforcement Management	Increasing the rewards that come from positive behaviour and reducing those that come from negative behaviour
Self-liberation	Believing in one's ability to change, make commitments and act on that belief
Stimulus Control	Using reminders and cues that encourage healthy behaviour as substitutes for those that encourage the unhealthy behaviour

These findings are supported by Kim, Hwang and Yoo (2004) and Jackson and colleagues (2007), who found significant improvements in physical activity levels and stage of change in individuals with Type 2 diabetes receiving a TTM-based intervention. However, all three of these studies were limited by their small sample (n=26 to 45), short terms changes (5 to 12 weeks), and lack of exploration of the other components of the TTM, including processes of change, decisional balance or self-efficacy.

Further studies have built on these initial findings by investigating all four constructs of the TTM with larger samples of people with Type 2 diabetes. Plotnikoff et al (2010) provided greater insight into the process of TTM-based behaviour change by measuring TTM constructs in a large sample (n=1157) at baseline and 6 months; with the objective being to predict stage transition over 6 months based on baseline results. Forward transitions from each stage of change were predicted using the Processes of Change questionnaire (Plotnikoff, Hotz, Birkett, & Courneya, 2001), a thirteen-item self-efficacy scale (Plotnikoff, Lippke, Courneya, Birkett, & Sigal, 2008), and a decisional balance scale (Plotnikoff, Blanchard, Hotz, & Rhodes, 2001). Strategies targeting self-efficacy, decisional balance and *experiential* processes of change were significantly associated with stage progression for individuals in pre-action stages of change; and the use of *behavioural* processes of change were more effective for individuals in the action or maintenance stage of change.

Further work by Kirk and colleagues (2003) provided insight into the processes of change used by individuals receiving a TTM-based intervention (n=70). The TTM-based intervention group showed significant changes at 6-months in both stage of change and physical activity levels compared with the control group. In particular, analyses of the processes of change showed an increased use of *self-liberation, counter-conditioning,* and *self-re-evaluation.* Kirk undertook a long-term follow-up of this sample at 12-months (2004), which found a greater number of intervention participants were in active stages of change compared with the control group. All process of change (with the exception of dramatic relief and stimulus control) were used by the intervention group.

More recently, Kirk et al (2010) explored the role of the TTM in older adults with Type 2 diabetes and/or cardiovascular disease (n=85). Findings showed that as stage of change increased, participants reported increased use of processes of change, in particular *consciousness raising, self-liberation, helping relationships, reinforcement management and counter-conditioning.* Experiential processes of change were used with greater frequency in the preparation stage of change, compared with the other stages. Participants also reported greater levels of physical activity, self-efficacy and pros towards participation during the maintenance stage of change.

The majority of studies investigating the TTM within people with Type 2 diabetes, however, lack participants in the pre-contemplation stage of change. Adams and White (2003) argue the necessity of including participants in all stages of change to thoroughly investigate the role of stage matched interventions. In reality, individuals in the pre-contemplation stage of change are difficult to reach. Further research is required to determine the best approach in reaching people in the pre-contemplation stage of change.

Findings from TTM studies highlight the complex relationship between many variables in the initiation and maintenance of physical activity behaviour change in people with Type 2 diabetes. Research has proposed that physical activity interventions should include specific strategies to address the key TTM components of a) self-efficacy, b) decisional balance, and c) experiential and behavioural processes of change. An overview of commonly used strategies is provided in Table 2.4.

Table 2.4. Behaviour change techniques used to address the key components of the Transtheoretical Model (from Kirk, Barnett & Mutrie, 2007

Components	**Physical activity consultation strategy**	**Description of strategy**
Decisional balance	Decisional balance table	Review pros and cons of becoming more active
Self-efficacy	Discuss suitable activity opportunities	Provide realistic opportunities for success and achievement. Discuss people in similar situation who have been successful in changing their physical activity behaviour
Processes of change		
Consciousness raising	Decisional balance table. Discuss current recommendations	Discuss benefits of being more physically active. Discuss the current physical activity recommendations
Dramatic relief	Decisional balance table	Discuss the risks of inactivity
Environmental re-evaluation	Decisional balance table	Emphasise the social and environmental benefits of physical activity
Self re-evaluation	Review current physical activity status and assess values related to physical activity	Review of current physical activity status and assess values related to physical activity
Social liberation	Discuss suitable activity opportunities	Raise awareness of potential opportunities to be active and discuss how acceptable and available they are to the individual
Counter conditioning	Discuss suitable activity opportunities	Discuss how to substitute inactive options for more active ones
Helping relationships	Establish social support	Seek out friends, family, colleagues who can provide support
Reinforcement management	Relapse prevention strategies	Reward successful attempts to be active

Self liberation	Goal setting	Make commitments for activity
Stimulus control	Relapse prevention	Identify situations that may have a negative impact on physical activity behaviour change and develop ways to prevent relapse during these situations

2.3.3 Behaviour change techniques

The exploration of various models of behaviour change has identified key behaviour change strategies that support individuals to change their health-related behaviour. Some of these have already been discussed, in addition to Table 2.4 providing an overview of behaviour change techniques used to support the TTM's ten processes of change. The terminology used to describe behaviour change techniques varies across published articles therefore Abraham and Michie (2008) compiled a taxonomy of techniques used in lifestyle interventions to encourage researchers to describe their methods using standard and consistent terminology. This taxonomy was updated by Michie et al (2011), further contributing to the standardisation of behaviour change techniques used in the promotion of physical activity and healthy eating behaviours. Forty individual behaviour change techniques were identified by the updated taxonomy. These are noted in Table 2.5. More recently the taxonomy table has been updated to recognise 93 individual behaviour change techniques (Michie et al., 2013).

Table 2.5. Forty individual behaviour change techniques identified by Michie et al (2011)

1. Provide information on consequences of behaviour in general	19. Provide feedback on performance
2. Provide information on consequences of behaviour to the individual	20. Provide information on where and when to perform the behaviour
3. Provide information about others' approval	21. Provide instruction on how to perform the behaviour
4. Provide normative information about others' behaviour	22. Model/Demonstrate the behaviour
5. Goal setting (behaviour)	23. Teach to use prompts/cues
6. Goal setting (outcome)	24. Environmental restructuring
7. Action planning	25. Agree behavioural contract
8. Barrier identification/problem solving	26. Prompt practice
9. Set graded tasks	27. Use of follow-up prompts
10. Prompt review of behavioural goals	28. Facilitate social comparison
11. Prompt review of outcome goals	29. Plan social support/social change
12. Prompt rewards contingent on effort or progress towards behaviour	30. Prompt identification as role model/position advocate
13. Provide rewards contingent on successful behaviour	31. Prompt anticipated regret
14. Shaping	32. Fear arousal
15. Prompting generalisation of a target behaviour	33. Prompt self-talk
16. Prompt self-monitoring of behaviour	34. Prompt use of imagery
17. Prompt self-monitoring of behavioural outcome	35. Relapse prevention/coping planning
18. Prompting focus on past success	36. Stress management/emotional control training
	37. Motivational interviewing
	38. Time management
	39. General communication skills training
	40. Stimulate anticipation of future rewards

Several reviews of the literature have identified some of these behaviour change techniques as particularly effective in promoting physical activity behaviour change. Bird et al (2013) found that in studies promoting walking and cycling in the general population the most frequently used techniques were *intention formation* and *self-monitoring* (Table 2.5, Items 5, 6, 16 & 17). In another review of articles exploring physical activity interventions for obese individuals, Olander et al (2013) found different behaviour change techniques to be associated with effectiveness, including: *teach to use prompts, prompt practice,* and *prompt rewards contingent on effort or progress towards behaviour* (Table 2.5, Items 12, 23 & 26). This suggests that different behaviour change techniques may be more appropriate for different activities or different populations. Only one review has explored the application of behaviour change techniques in the diabetes population (Avery, Flynn, van Wersch, Sniehotta, & Trenell, 2012). Their review of theory-based physical activity interventions (RCT's) identified ten specific behaviour change techniques and examples that were associated with significant improvements in glycaemic control (HbA1c). These included:

- providing information on the consequences specific to the individual (e.g. information about the benefits and costs of physical activity to individuals) (Table 2.5, Item 2).
- goal setting [behaviour] (e.g. supporting individuals to make specific, measurable, achievable, relevant, and timely physical activity goals) (Table 2.5, Item 5).
- barrier identification/problem-solving (e.g. identifying potential barriers to physical activity and methods to overcome them) (Table 2.5, Item 8).
- prompt review of behavioural goals (e.g. review whether physical activity goals were achieved followed by revisions) (Table 2.5, Item 10).
- prompting generalization of a target behaviour (e.g. once physical activity is performed in one situation, the individual is encouraged to try it in another) (Table 2.5, Item 15).
- prompting focus on past success (e.g. identifying previous successful attempts at physical activity) (Table 2.5, Item 18).
- provide information on where and when to perform physical activity (e.g. tips on places and times to access local physical activity opportunities) (Table 2.5, Item 20).

– use of follow-up prompts (e.g. telephone calls in place of face-to-face sessions to support maintenance) (Table 2.5, Item 27).
– time management (e.g. making time to be active) (Table 2.5, Item 28).
– plan social support/social change (e.g. encourage individuals to gain social support from others to help achieve physical activity related goals) (Table 2.5, Item 29).

Findings from the Avery et al (2012) review also suggested that interventions using more than ten behaviour change techniques resulted in significantly greater glycaemic control.

2.4 Summary of models of behaviour change

Evidence suggests that interventions founded on theoretical models of behaviour change are more effective than non-theory based interventions (Kahn et al., 2002). Therefore, applying components of behaviour change models (such as the TPB or TTM) is important in the development and implementation of physical activity interventions for people with Type 2 diabetes.

Various guidelines on physical activity for Type 2 diabetes recommend the development of physical activity interventions is based on valid theoretical frameworks (Colberg et al., 2010; Scottish Intercollegiate Guidelines Network, 2010b). As a result, more published research with Type 2 diabetes now reports on the theoretical model used for the physical activity intervention. In many studies, interventions are based on a single model (e.g. the TTM), while some interventions use a combined approach of several models (e.g. the Social Cognitive Theory and the TTM) (Avery et al., 2012; Greaves et al., 2011). The use of appropriate behaviour change techniques, which address specific components of the chosen behaviour change model, are important in supporting individuals with Type 2 diabetes to increase their levels of physical activity. In addition to the TPB and TTM, a variety of theoretical models of behaviour change exist e.g. Social Cognitive Theory (Bandura, 1989) and the Health Belief Model (Rosenstock, 1974). Further research is required to explore their potential use for individuals with diabetes.

The remainder of this chapter will now focus on literature which has explored the effectiveness of various intervention methods for physical activity promotion in adults with Type 2 diabetes.

2.5 Type 2 diabetes and physical activity behaviour change: the evidence base

The following review of literature relates to the delivery of physical activity interventions for Type 2 diabetes in a *research setting*. The translation and implementation of research findings into *everyday practice* is subsequently discussed in detail in Chapter 3, where findings are presented in the form of a published peer reviewed systematic review (Matthews, Kirk, MacMillan, & Mutrie, 2013).

The literature discussed in this section is presented as a narrative summary. The aim is to summarise the main evidence-based physical activity interventions undertaken to date for Type 2 diabetes. I attempted to capture all available literature on the topic by undertaking multiple database searches using key search terms (outlined in Table 2.6). The reference lists of key papers were also searched for relevant studies and the research work of key authors in the field was followed to capture follow-up results or new interventions. A final search of the literature was performed in August 2013 to ensure all up-to-date publications were included.

Various intervention approaches have shown effectiveness in the initiation and maintenance of physical activity behaviour change in people with Type 2 diabetes. Each method has strengths and limitations, and to date, there is no consensus on the most effective method of intervention delivery.

Before providing a summary of individual physical activity studies for adults with Type 2 diabetes I will firstly present the findings from several systematic reviews of the diabetes literature to provide a brief introductory overview.

Table 2.6. Key phrases and electronic databases searched for literature review

Databases Searched	**Key Search Terms**
Ovid – MEDLINE – EMBASE EBSCO – SPORTDiscus – PsycINFO – PsycARTICLES	(diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise) AND (behaviour change OR consultation OR counselling OR telephone OR walking OR pedometer OR group OR structured OR education)

An extensive review by Greaves et al (n=30 studies) (2011) found that the most effective physical activity interventions for people with Type 2 diabetes used standard behaviour change techniques (e.g. goal-setting, problem solving), engaged social support, targeted both diet and physical activity, and were associated with greater frequency of participant/counsellor contact. These findings were supported by a recent review by Avery et al (2012) which explored the methods of seventeen RCT's delivering behavioural interventions to increase physical activity in adults with Type 2 diabetes. Significant improvements in both physical activity and health outcomes were found with theory based interventions using multiple behaviour change techniques. The most frequently used behaviour change techniques included goal-setting, prompts, self-monitoring, problem solving, social support and relapse prevention. Additional findings in a review by Kavookjian et al (n=41 studies) (2007) reported that interventions were effective when tailored to the needs of individual participants, and delivered in the form of structured physical activity training. These findings were further supported in a review by Umpierre et al (n= 47 studies) (2011) which found structured physical activity training to be more effective than physical activity advice alone in achieving the current physical activity guidelines. However, effectiveness of structured training programmes following completion was not evaluated due to the majority of studies being of short duration. Umpierre et al also proposed intensive interventions, encouraging physical activity greater than 150-mins per week, were more effective than those of lower intensity. They also found interventions to be more effective when physical activity advice was delivered in combination with dietary advice. Finally, individual physical activity consultation has also been shown to effectively increase levels of physical activity. Kirk et al (2007) developed evidence-based consultation guidelines, which recommend that physical activity information be tailored to an individual's stage of change, and delivered by methods which address theoretical components of behaviour change.

Overlap of intervention methods exists in many studies. Therefore, to aid interpretation, the following review of literature has been structured by categorising five methods of physical activity promotion commonly used for people with Type 2 diabetes. Findings will be discussed in relation to the *main* method of intervention delivery for each study:

a) Physical activity consultation
b) Telephone-delivered interventions
c) Pedometer-based interventions
d) Group-based approaches
e) Structured physical activity approaches.

Tables 2.7-2.11 provide a summary of intervention characteristics for the main studies discussed in the following review of literature. Several studies address more than one method of intervention delivery and therefore appear in more than one table.

2.5.1 Methods of physical activity promotion

2.5.1.1 Physical Activity Consultation

Guidance on physical activity delivered on a one-to-one basis and tailored to an individual's stage of behaviour change is known as *physical activity consultation* (Biddle & Mutrie, 2008; Loughlan & Mutrie, 1995). In some older studies physical activity consultation is referred to as *exercise consultation.* This change reflected the shift in focus to promoting physical activity participation as opposed to exercise participation. In keeping with the current guidelines and the focus on physical activity we will continue to use the term physical activity consultation throughout this thesis.

Physical activity consultation is typically based on the TTM and employs a semi-structured approach enabling the participant to guide elements of the consultation. This patient-centred method allows participants to take ownership and responsibility for their behaviour change (Rollnick et al., 2005). Consultations therefore vary between participants, with different behaviour change strategies being used for each individual.

Physical activity consultations are known to be effective in the initiation and maintenance of physical activity in people with Type 2 diabetes (Kirk et al., 2007). Many studies report that individuals who undertake physical activity consultation have greater improved levels of physical activity when compared with non-consultation control groups. Following a review of the evidence base, Kirk and colleagues developed physical activity consultation guidelines for adults with Type 2 diabetes (2007). These guidelines, based on the TTM, continue to be used by researchers in the development of physical activity interventions for people with and without diabetes (Fitzsimons et al., 2012; Matthews, 2013b).

Positive findings of interventions using physical activity consultation (presented in Table 2.7) show this to be an effective method of physical activity promotion within the diabetes population (Balducci et al., 2012; Balducci, Zanuso, Massarini, & et al, 2008; Balducci et al., 2010; Di Loreto et al., 2005; Di Loreto et al., 2003; Jackson et al., 2007; Kirk, Barnett, Leese, & Mutrie, 2009; Kirk et al., 2003, 2004; Plotnikoff et al., 2011). As a result, guidelines, published by organisations such as the Scottish Intercollegiate Guidelines Network (2010), recommend the use of physical activity consultation as an effective method of behaviour change in people with diabetes. In general, however, the majority of studies exploring the use of physical activity consultation have been limited by interventions of short duration and absence of long-term follow-up (Table 2.7). The delivery of physical activity consultation, face-to-face with participants, can be time-consuming (Napolitano & Marcus, 2002), therefore the use of physical activity consultation via tailored print-based materials has also been explored (Dutton, Provost, Tan, & Smith, 2008; Kirk et al., 2009). To date findings are inconclusive and requires further research due to the potential for delivering tailored information to a wider audience with a minimal strain on resources. Physical activity consultation may be the most effective for individuals with Type 2 diabetes who require individual in-depth support (Kirk et al., 2009). Although effective, it may not be a feasible method for the diabetes population as a whole.

Research gaps in the physical activity consultation literature

Several gaps exist in the current literature. Firstly, the delivery of physical activity consultation requires specific behaviour change skills. These include an ability to a) make participants feel comfortable, b) detect and facilitate communication about fears and worries, c) deliver appropriate information tailored for an individual's stage of change, and d) guide participants through the various processes of behaviour change. The effectiveness of physical activity consultation is therefore associated with the skills of individual staff. Limited studies, however, detail the behaviour change training provided to staff delivering physical activity consultations. Secondly, very few studies comment on fidelity to the physical activity consultation guidelines. Study protocols do not necessarily translate easily into practice, therefore the intervention may not be conducted as outlined in the methods. Qualitative insight from research staff is useful to help understand the challenges of implementing physical activity consultation within the diabetes population. Finally, there is lack of information gained from participants. Outcome measures typically focus on diabetes control (e.g. HbA1c) and physical activity levels (e.g. accelerometer). However, ultimately, the participant is responsible for their behaviour change. It is therefore crucial to gain an understanding of why individuals do or do not increase their physical activity following a physical activity consultation intervention.

2.5.1.2 Telephone-delivered interventions

Individual face-to-face consultations, although effective, are a resource intensive method of delivering physical activity promotion within diabetes care. The potential for alternative methods has been explored. In particular, the role of physical activity promotion via telephone consultation has been widely researched. The majority of households have access to a telephone therefore this approach has the potential to reach a wide audience. It may also reduce barriers including: travel-costs to and from diabetes clinics or primary care facilities, and scheduling of appointments (Eakin, Lawler, Vandelanotte, & Owen, 2007). With the potential to reach a wide population, utilising minimal resources, telephone counselling may have a role to play in targeting diabetes via physical activity promotion. Several systematic reviews of the literature have found strong evidence for the efficacy, and cost-effectiveness, of telephone delivered consultations in the initiation and maintenance of behaviour change in the general population (Eakin et al., 2007; Goode, Reeves, & Eakin, 2012; Graves et al., 2009).

Studies exploring the effectiveness of telephone counselling in adults with Type 2 diabetes have found mixed results (Table 2.8) (Eakin et al., 2008; Eakin, Reeves, Winkler, Lawler, & Owen, 2010; Plotnikoff, Courneya, et al., 2010; Plotnikoff, Johnson, et al., 2010; Plotnikoff et al., 2012; Richter et al., 2008). Several of these studies reported significant increases in levels of physical activity (Di Loreto et al., 2003; Eakin et al., 2008; Eakin et al., 2010; Richter et al., 2008), some of which were maintained long-term at 2-year follow-up (Di Loreto et al., 2003).

Table 2.7. Summary characteristics of studies using physical activity consultation

Author *Country*	*Design & Aim* *Theoretical framework*	*Participants*	*Duration*	*Intervention & Outcomes*	*Findings*
Balducci et al, 2008, 2010 & 2012 *Italy* *The Italian Diabetes and Exercise Study (IDES)*	Multi-centre RCT Aim: to improve glycaemic control via structured PA participation Theory: combined (SET, SCT, TPB)	N=606 42.1% female Mean age: 58.8±8.6yrs	12-months Follow-up: 12-months	Control group: standard care of physical activity counselling every 3-months for 12-months. Intervention group: two 75-min structured & supervised PA sessions per week in addition to standard care Outcome measures: HbA1c, VO2max, CV risk profile, levels of unsupervised PA	At 12-month follow-up: Intervention group showed significantly greater reduction in HbA1c compared with the control group (0.42% vs 0.13%, $P<0.001$). Intervention group also showed significantly greater changes in levels of PA, VO2max, and CV risk profile ($P<0.001$) compared with control group. Control group showed significant improvements from baseline in levels of PA, fasting blood glucose, VO2max, SBP, DBP, LDL cholesterol and waist circumference ($P<0.001$)

Di Loreto et al, 2003 & 2005 *Italy*	RCT & post-hoc analysis Aim: to assess the effect on increased energy expenditure on health and financial outcomes Theory: combined (SET, SCT, TPB)	N=340 (intervention) 53% female Mean age: ranged from 61.8 – 62.0yrs _________ N=179 (financial analysis) % female not reported Mean age: 62.0 ± 0.7yrs	2-years Follow-up: 0, 3 & 24-months	Control group: one 30-min PAC. Intervention group: initial 30-min PAC, a follow-up telephone call at 1-month, followed by seven 15-min face-to-face PAC's every 3-months. Intervention was delivered by a physician Outcome measures: HbA1c, PA METS (MAQ), BMI, direct and indirect medical & social costs	At 2-year follow-up: No significant change in health outcomes or financial costs in participants with <6.8METS per hour per week. Significant improvements in health outcomes and reduced financial costs was observed with increased energy expenditure >17.1METs per hour per week. Participants achieving change of >17.1METs per hour per week reduced annual costs by $386 per year (*P*<0.0001), compared with those achieving change of >58METs per hour per week who reduced annual costs by $2000 per year (*P*<0.0001)
Dutton et al, 2008 *USA*	RCT Aim: to examine the effects of a tailored, print-based intervention for promoting physical activity among patients	N=85 68.2% female Mean age: 57.1±9.8yrs;	4-weeks Follow-up: 4-weeks	Control group: received usual care consisting of a dietary information sheet. Intervention group: received a stage-targeted PA booklet at baseline and a 2-page tailored letter at 1-week Outcome measures: PA (PAR), SOC	At 4-week follow-up: Compared with the control group, participants receiving the intervention were more likely to progress their SOC from baseline (OR=3.2, 95% CI 1.0–10.3) and were more likely to be in the Action or Maintenance stages (OR=5.6, 95% CI 1.7–18.3).

	with T2D Theory: combined (TTM and SCT)				A non-significant between-group difference was found with the intervention group reporting 22-mins greater than the control group (*P*=0.22)
Kirk et al, 2003 & 2004 *UK*	RCT Aim: to evaluate the effect of PAC on PA and clinical outcomes at 6 months in people with T2D Theory: TTM	N=70 50% female Mean age: 57.6 ± 7.9yrs	3-months Follow-up: 6 & 12-months	Control group: received a standard PA education leaflet. Intervention group: received two individual face-to-face PAC session and four follow-up support phone calls at 1, 3, 7 & 9-months Outcome measures: PA (accelerometer & PAR), SOC, ETT, various clinical outcomes	At 6 and 12-month follow-up: Significant differences between groups were recorded for physical activity (P<0.01). The intervention group increased levels of physical activity from baseline to 6 months (P<0.01), with no decrease from 6 to 12 months (P>0.05). In the control group, accelerometer counts per week decreased from baseline to 12 months (P=0.03). At 6-month follow-up: A greater number of intervention participants increased stage of change (X^2 22.6, P <0.001). Significant differences were recorded between the intervention and control group for change in HbA1c (-0.26% vs 0.15%), SBP(-7.7mmHg vs 5.6mmHg) and fibrinogen (-0.28mmol/l vs 1.43mmol/l). No

					significant differences were recorded in other measured variables
Kirk et al, 2009 *UK*	RCT Aim: to compare the effectiveness of two methods of PAC compared with usual care on PA and clinical outcomes in adults with T2D Theory: TTM	N=134 51% female Mean age: ranged from 59.2 to 63.2yrs	12-months Follow-up: 6 & 12-months	Control group: standard information leaflet at baseline & 6-months. Intervention group 1: two 30-minute face-to-face consultations at baseline & 6-months using a witten PA Pack. Intervention group 2: PAC in written form was given to participants to work through in their own time Outcome measures: PA (accelerometer & PAR), BMI, HbA1c, multiple clinical outcomes	At 6 & 12-month follow-up: Neither PAC delivered face-to-face or in written form was better than standard care at improving PA levels or health outcomes. At 12-month follow-up: A subgroup analysis of participants with low PA (baseline pedometer steps < 5000 /day) found the PAC delivered face-to-face significantly increased PA compared with the control group who showed a significant decrease. All groups demonstrated improvements in TC, HDL, waist circumference, SBP, & DBP. HbA_{1c} improved over 6 months

Jackson et al, 2007 *UK*	RCT Aim: to explore the effect of PAC delivered by a dietitian for adults with T2D Theory: TTM	N=40 47% female Mean age: ranged from 58..4-62.1yrs	One session Follow-up: 6-weeks	Control group: received PA information leaflet. Intervention group: one face-to-face PAC delivered by a dietitian, in addition to PA information leaflet Outcome measures: PA & SOC (from PAQ)	At 6-week follow-up: A significant between-group difference was observed for changes in PA. A significant change in PA was reported for the intervention group alone (F[1,32]=15.99, P<0.01). A significant between-group difference was observed for rates of progression in SOC (P<0.007)
Plotnikoff et al, 2011 *Canada*	RCT Aim: to explore the effects of a standard education program compared with a supplemental PA intervention on diabetes-related health outcomes Theory: TPB	N = 96 60% female Mean age: 60yrs (range 27-78)	4.5-months Follow-up: 3, 6 & 12-months	Control group: received 11 group sessions as part of standard care. Intervention group: same as control group but received an additional 2 face-to-face sessions and 13 telephone calls of decreasing frequency over 4.5 months. Sessions delivered by a Diabetes Educator, Personal Trainer or Nurse Outcome measures: HbA1c, PA (GLTQ), BMI	At 12-month follow-up: Compared with the control group the intervention group demonstrated a significant increase in PA (P < 0.01) and cardiorespiratory fitness (P < 0.05) from baseline to all follow-up time-points. HbA1c levels declined (P < .05) from baseline to all time points in the control group

Abbreviations. SET: Social Ecological Theory, SCT: Social Cognitive Theory, TPB: Theory of Planned Behaviour, TTM: Transtheoretical Model of Change, PA: physical activity, PAC: physical activity consultation, PAR: 7-day physical activity recall, PAQ: physical activity questionnaire, MAQ: Modified Activity Questionnaire, GLTQ: Godin Leisure Time Questionnaire, SBP: systolic blood pressure, DBP: diastolic blood pressure, SOC: stage of change, ETT: exercise tolerance test

In contrast, research by Plotnikoff and colleagues (2010) on the Alberta Diabetes and Physical Activity Trial (ADAPT) found no significant between-group differences. However, following further analysis for gender tailored telephone counselling was found to be an effective method of increasing levels of physical activity in women with Type 2 diabetes. In further research by Plotnikoff and colleagues the use of peer-counsellors to deliver telephone interventions was found to be feasible method of physical activity promotion for people with Type 2 diabetes (Plotnikoff, Johnson, et al., 2010). The use of peer counsellors has potential for cost-effective delivery of physical activity promotion within the diabetes population and would benefit from further study.

Telephone-delivery of physical activity promotion within the diabetes population continues to be a topic of research. The results of several on-going studies are anticipated in 2014, which may add a significant contribution to the telephone delivery evidence base. Firstly, the Living Well with Diabetes study, currently being undertaken by Eakin and colleagues (2010), attempts to address several gaps in the telephone counselling literature by delivering an 18-month weight loss intervention aimed at promoting maintenance of physical activity and dietary behaviour change long-term. The ambitious protocol aims to promote 210-mins of moderate physical activity per week; higher than the current recommendation of 150-mins per week. This is in line with research suggesting that a higher duration of physical activity is required in people with Type 2 diabetes for favourable change in health outcomes (Geidl & Pfeifer, 2011). Secondly, the role of social support in telephone consultations is being explored by Trief et al (2011), who have set out to explore whether a telephone intervention delivered to ‘couples’ is more effective than interventions delivered to individuals. It is known that the role of social support is integral to behaviour change of individuals with Type 2 diabetes (Khan, Stephens, Franks, Rook, & Salem, 2012), therefore the results of this study may provide an interesting insight.

Research gaps in the telephone delivery literature

Several gaps exist in the telephone delivery literature. Firstly, while it has been suggested that women respond to telephone-delivery more than men, no qualitative insight has been collected from participants to explore this issue. Secondly, although staff training was outlined well in the majority of studies, information was lacking on fidelity to the telephone protocols. As mentioned in the previous *physical activity consultation* section, assessment of fidelity is an indicator of the intervention protocols feasibility when implemented in practice (Glasziou et al., 2010). Finally, some findings from telephone studies suggest that participants who drop-out of the interventions are those with the lowest levels of physical activity. Qualitative insight is required here to explore the reasons for non-participation.

2.5.1.3 Pedometer-based interventions

Walking is known to be a safe and effective method of physical activity participation for the majority of people (Ogilvie et al., 2007). The use of pedometers in the promotion of walking activity has been extensively researched and is now widely accepted as a standard promotion tool that is both easy to use and cost-effective (Bravata et al., 2007; Shaw et al., 2011). Pedometers have been identified as one of the most effective methods of physical activity promotion (Heath et al., 2012). They address several behaviour change strategies, for example: goal-setting (individuals may set achievable daily step goals), self-monitoring (record daily steps in a step-diary), self-efficacy (improve confidence in walking ability), problem-solving (adapt walking behaviour to suit weather and setting), motivation (provide instant feedback to individuals), and social support (may act as a visual prompt for friends and family) (Bravata et al., 2007; Chan & Tudor-Locke, 2008).

Evidence suggests that pedometers are a motivational tool that may improve individuals walking activity by 2000-2500 steps per day (Bravata et al., 2007). While several systematic reviews have reported evidence to support the short-term

Table 2.8. Summary characteristics of studies using telephone intervention methods

Author *Country*	*Design & Aim* *Theoretical Framework*	*Participants*	*Duration*	*Intervention & Outcomes*	*Findings*
Eakin et al, 2008 & 2010 *Australia* *The Logan Healthy Living Study*	RCT *Aim*: to examine the maintenance of behavioural changes 6 months following a telephone-delivered PA & diet intervention Theory: Combined (SCT & SEM)	N=434 61.1% female Mean age: 58.2 ±11.8yrs	12-months Follow-up: 12 & 18-months	Control group: received feedback from assessments but no intervention. Intervention group: PAC via telephone in an intensive call phase (10 calls over 4 months) followed by a maintenance phase (8 calls over 8 months) Outcome measures: PA (Active Australia survey), diet (FFQ)	At 18-month follow-up: Significant improvements in PA from baseline in both the control and intervention group were observed at 12-months and maintained at 18-months (62.2 +/- 14.2 versus 74.7 +/- 14.9 minutes/week respectively, $P<0.001$). Significant between-group maintenance effects were found for dietary outcomes ($P<0.05$)
Plotnikoff et al, 2010 & 2012 *Canada*	3-armed RCT Aim: to explore the effectiveness of two strategies to increase PA and reduce HbA1c in adults with T2D	N=287 % female ranged from 41-51%	12-month Follow-up: 3, 6, 9, 12 & 18-months	Group 1 received a standard information leaflet. Group 2 also received the usual care leaflet, in addition to a pedometer and print-based materials, delivered by post every 3 months for 12 months). Group 3 received the same intervention as Group 2, with the addition of tailored telephone counselling, including 15-minute	At 12-month follow-up: No significant between-group change was found for any outcome. Following analysis for gender a significant increase in step counts was observed between the control group and Group 3 for women (5964 steps, -1540 to 10338,

The ADAPT Study	Theory: Combined (TPB, TTM, SCT, HBM, PMT)	Mean age: ranged from 61.0 to 62.3yrs		telephone consultations by trained staff, delivered with decreasing frequency over 12-months Outcome measures: PA (GLTQ & pedometer), HbA1c, psychological wellbeing (SF-12, EQ5D)	*P*=0.008)
Plotnikoff et al, 2010 *Canada*	Longitudinal cohort case studies Aim: to determine the feasibility and efficacy of peer-led PA telephone counselling for people with T2D Theory: SCT	N=8 37.5% female Mean age: 59.5 ±6.5yrs	3-months Follow-up: 3-months	Twelve weekly telephone calls of 10-15min duration, aimed at increasing both aerobic physical activity and resistance activity. Intervention delivered by peers Outcome measures: PA (GLTQ)	At 3-month follow-up: No significant change was found for aerobic PA (z=-0.7, *P*=0.48) or resistance PA (z=-1.58, *P*=0.12)

Richter et al, 2008	RCT Aim: to explore the effect of a 3-month telephone intervention on PA and CV risk factors in adults with T2D Theory: not reported	N=42 % female not reported Mean age: not reported	3-months Follow-up: 3-months	Control group: no intervention. Intervention group: received weekly telephone PAC for 12-weeks Outcome measures: PA, clinical outcomes (BMI, SBP, HbA1c, weight, waist circumference, TG, FBS)	At 3-month follow-up: PA increased in the intervention group with a significant between-group difference. Significant between-group differences were demonstrated for weight, BMI, waist circumference, TG and FBS. No changes were found for SBP or HbA1c

Abbreviations. SCT: Social Cognitive Theory, SEM: Social Ecological Model, HBM: Health Belief Model, PMT: Protection Motivation Theory, TPB: Theory of Planned Behaviour, TTM: Transtheoretical Model of Change, PA: physical activity, PAC: physical activity consultation, GLTQ: Godin Leisure Time Questionnaire, SBP: systolic blood pressure, FFQ: Food Frequency Questionnaire, FBS: fasting blood sugar, SF-12: Short-form-12 Health Survey, EQ5D: Euro-QoL-5 dimension survey effectiveness (<12-weeks) of such interventions, long-term effectiveness remains unclear and requires further exploration (Ogilvie et al., 2007). In order for walking programmes to be effective, Ogilvie et al (2007) suggested that interventions should, a) target sedentary individuals or those motivated to change, b) be tailored to the needs of the individual, and c) be delivered via group-based, individual or household approaches. Additional guidance also recommends the use of pedometers as part of a programme which support in the form of goal-setting, monitoring and feedback (National Institute for Health and Care Excellence, 2012). Based on these findings it is clear why walking is therefore considered an appropriate method of physical activity promotion for adults with Type 2 diabetes i.e. they are often sedentary individuals, aware of their need for lifestyle change, and in need of tailored information and social support from peers, family or friends.

There is a growing evidence base for the effectiveness of pedometers for people with Type 2 diabetes (Table 2.9). Several studies have shown pedometer-based interventions to significantly increase physical activity in the short-term (Furber et al., 2008; Negri et al., 2010; Tudor-Locke et al., 2004; Tudor-Locke, Myers, & Wilson Rodger, 2001), with several studies showing maintenance of behaviour change in the long-term (De Greef, Deforche, Tudor-Locke, & de Bourdeaudhuij, 2010, 2011). While walking interventions have been shown to be effective in increasing step counts in people with Type 2 diabetes, a lack of evidence is available to show that key health outcomes are achieved (Table 2.9). Some research suggests that although people with Type 2 diabetes may successfully achieve the current physical activity guidelines, the intensity of activity may be insufficient to gain measurable health benefits (Araiza, Hewes, Gashetewa, Vella, & Burge, 2006; Johnson, Boule, Bell, & Bell, 2008). Johnson et al (2006) attempted to address this issue by designing an intervention to increase the walking *speed* of participants who had previously completed the First Step Program (Tudor-Locke, 2009; Tudor-Locke et al., 2001, 2004). The findings suggested that increased walking intensity resulted in greater improved health outcomes in people with Type 2 diabetes who were already walking ~10,000 steps per day. Evidence also suggests that individuals with Type 2 diabetes who achieve a greater intensity of walking significantly reduce their medication costs compared with individuals who walk at a lower intensity (Di Loreto et al., 2005) (Table 2.9).

Research gaps in the pedometer-based intervention literature

Several gaps in the literature exist for pedometer-based interventions. In particular, further research is needed to determine the long-term effectiveness of walking behaviour in people with Type 2 diabetes. There is also potential for a wide range of people to deliver pedometer-based interventions. Further exploration within primary care, secondary care and the community is required. Finally, limited insight is available from staff and participants with Type 2 diabetes regarding their experiences of pedometer-based physical activity interventions. This information is important for the future development of effective interventions.

2.5.1.4 Group-based approaches

Many of the studies already presented in this chapter have involved the delivery of physical activity information to *individuals* with Type 2 diabetes. However, many studies (including the majority of pedometer-based walking interventions) have highlighted the potential role of the group-based approach. Theoretical models of behaviour change include components related to motivation, problem-solving and social support. Group-based interventions have the potential to address many of these theoretical components, in the form of peer-based support and motivation.

Group-based interventions have been shown to be effective in promoting physical activity and health outcomes in adults with Type 2 diabetes (Table 2.10) (Davies, Heller, Skinner, & Campbell, 2008; De Greef et al., 2011; Diedrich, Munroe, & Romano, 2010; Vadstrup, Frolich, Perrild, Borg, & Roder, 2011; Wadden et al., 2011).

Table 2.9. Summary characteristics of studies using pedometer interventions

Author *Country*	*Design & Aim* *Theoretical Framework*	*Participants*	*Duration*	*Intervention & Outcomes*	*Findings*
De Greef et al, 2010 *Belgium*	RCT Aim: to investigate the benefits of a pedometer and behavioural group intervention for promoting PA Theory: combined (CBT, SCT, TTM, MI)	N=41 31.7% female Mean age: 35-75yrs (SD not reported)	3-months Follow-up: 3 & 12-months	Control group: standard care of one single group-education session. Intervention group: five 90-min group educations over 12 weeks, a booster session after 22 weeks and a pedometer. Delivered by health post-graduates Outcome measures: PA (accelerometer & pedometer), weight, HbA1c and multiple health outcomes	At 12-week follow-up: Intervention group had significantly increased their steps per day compared with control group (2502 versus 324 steps; *P*<0.05). Intervention group significantly reduced their sedentary behaviour by 1-hour per day (*P*<0.05). There was no significant effect on total PA or health outcomes. At 12-month follow-up: Intervention group maintained a significant trend for greater steps per day than the control group (924 versus -864 steps, *P*=0.1). Sedentary activity returned to baseline levels
De Greef et al, 2011 *Belgium*	RCT Aim: to compare effectiveness of a 12-	N=67 30% female	12-weeks Follow-up: 12-weeks	Three treatment arms (Group A-C). Group A: received three individual PAC by GP. Group B: received three PA group counselling sessions by a clinical	At 12-week follow-up: Group B significantly increased their steps per day compared with Group A and Group C (1706 versus 837

	week PA intervention via individual consultation or group delivery Theory: combined (CBT, TTM, SCT, MI)	Mean age: 67.4 ± 9.3yrs		psychologist. Group C: control group, received no intervention Outcome measures: steps per day (pedometer), PA (IPAQ) and multiple health outcomes	versus 313 steps, *P*<0.05). Group B significantly increased their self-reported PA by 82mins per day compared with Group C who reported a decrease of 21mins per day (*P*<0.05). Only Group B showed a significant improvement in health outcomes (*P*</=0.05)
Di Loreto et al, 2003 & 2005 *Italy*	RCT & post-hoc analysis Aim: to assess the effect on increased energy expenditure on health and financial outcomes Theory: combined (SET, SCT, TPB)	N=340 (intervention) 53% female Mean age: ranged from 61.8 – 62.0yrs _________ N=179 (financial analysis) % female not reported Mean age: 62.0 ± 0.7yrs	2-years Follow-up: 0, 3 & 24-months	Control group: one 30-min PAC. Intervention group: initial 30-min PAC, a follow-up telephone call at 1-month, followed by seven 15-min face-to-face PAC's every 3-months. Intervention was delivered by a physician Outcome measures: HbA1c, PA METS (MAQ), BMI, direct and indirect medical & social costs	At 2-year follow-up: No significant change in health outcomes or financial costs in participants with <6.8METS per hour per week. Significant improvements in health outcomes and reduced financial costs was observed with increased energy expenditure >17.1METs per hour per week. Participants achieving change of >17.1METs per hour per week reduced annual costs by $386 per year (*P*<0.0001), compared with those achieving change of >58METs per hour per week who reduced annual costs by $2000 per year (*P*<0.0001)

Furber et al, 2008 *Australia*	RCT Aim: to evaluate the effectiveness of a brief intervention using a pedometer and step-diary Theory: not reported	N=226 % female not reported Mean age: not reported	2-weeks Follow-up: 2 & 20-weeks	Control group: received general advice to increase physical activity. Intervention group: same as control group but with the provision of a pedometer and step diary to record daily steps for 2-week duration. Outcome measures: PA (Active Australia survey)	At 2-week follow-up: Compared with the control group, the intervention group reported significantly higher self-reported minutes of walking (223 versus 164 minutes, *P*=0.01), in addition to % achieving recommended levels of MPA (63.5% versus 41.8%, *P*=0.02). No significant between-group differences were found at 20-week follow-up
Johnson et al, 2006 *Canada*	Pre & post design Aim: to explore the effect of increased walking intensity on adults with T2D who were already achieving >10,000 steps per day Theory: combined (SCT & TTM)	N=11 27% female Mean age: 54.5 ± 7.5yrs	12-weeks Follow-up: 1, 4 & 12-weeks	Participants undertook 34 supervised walking sessions over 12-weeks where they walked at a cadence 10% faster than baseline. Participants were also encouraged to undertake supervised walking sessions at the faster cadence. Outcome measures: PA (accelerometer), CV fitness (Bruce-graded treadmill protocol)	At 12-week follow-up: Increased walking cadence resulted in significant improvements in CV fitness (no stats reported, *P*<0.05). PA data not reported
Negri et al, 2010	RCT	N=59	4-months	Control group: received standard recommendations to increase PA. Intervention group: 3 supervised 45-min	At 4-month follow-up: Intervention group showed significant reductions in HbA1c from baseline (-0.37%,

Italy	Aim*:* to evaluate the impact of a supervised walking programme Theory: not reported	Gender not reported. Mean age: 65.7 ± 5.0yrs	Follow-up: 4-months	walking sessions per week in addition to PAC at baseline and 2-months Outcome measures: HbA1C, 6-min walk test & prescription of diabetes medication	*P*<0.05). No between-group difference was found. Intervention group showed significantly greater improvement in the 6-min walk test compared with the intervention group (*P*<0.001). Reduction or discontinuation of diabetes medication was significantly greater in the intervention group compared with control group (33% versus 5%, *P*<0.05)
Tudor-Locke et al, 2001 & 2004 *USA*	RCT Aim*:* to examine the effectiveness of a theory-based pedometer intervention for adults with T2D Theory: combined (TTM & SCT)	N = 60 45% female Mean age: 52.7 ± 5.2 yrs	4-months Follow-up: 4 & 6-months	Control group: received no intervention. Intervention group: Four weekly group meetings for the first 4-weeks that included a group walk. Motivational postcards were mailed at 6 & 10-weeks. Delivered by PA experts and diabetes educators Outcome measures: HbA1c, PA (pedometer)	At 4-month follow-up: The intervention group significantly increased their PA from baseline (~3000 steps/day, (*P*<0.01), a significant improvement compared to the control group (*P*<0.0001). At 6-month follow-up: PA in the intervention group remained higher than the control group but this was no longer significant (7924±3308 versus 6557±2742 steps per day, *P*=0.17)

Abbreviations. CBT: cognitive behavioural therapy, MI: motivational interviewing, SCT: Social Cognitive Theory, TTM: Transtheoretical Model of Change, PA: physical activity, PAC: physical activity consultation, IPAQ: International Physical Activity Questionnaire

The majority of pedometer-based studies in the diabetes population have involved a group-based approach and reported short-term effectiveness in improving levels of physical activity. In particular, the study by De Greef et al (2011) was the only study to compare a group-based approach with individual counselling. They found that participants in the group-intervention increased their daily steps significantly more than the individual group (Table 2.10).

It has been suggested that the group structure allows participants to share their experiences and knowledge, enabling individuals to use problem-solving skills recommended by others in the group. The role of peers as positive role models, providing motivation and support, has also been highlighted by other group-based studies as facilitators of behaviour change (Bastiaens et al., 2009; Two-Feathers et al., 2007; van Dam et al., 2005). Group based approaches have the potential to target larger numbers of participants at one time, hence reducing the burden on staff and resources. However, delivery via group sessions is associated with several disadvantages. Group sessions require appropriate organisation and administration, with participants being provided with suitable venues and time allocations (De Greef et al., 2011). Many group-based interventions incorporate multiple aspects of diabetes education, typically diet and diabetes self-care management. This makes interpretation of the physical activity component challenging (Vadstrup, Frolich, Perrild, Borg, & Roder, 2009). Long-term effectiveness of group-based physical activity promotion is lacking.

Research gaps in the group-based literature

Several gaps in the literature exist for group-based physical activity promotion. Firstly, group-based interventions typically target multiple lifestyle behaviour. Evaluation of the physical activity component is therefore difficult to assess. A combination of objective and subjective measures of physical activity would help interpretation of the findings. Group-based interventions have the potential to be delivered by various health professionals, following provision of appropriate training and support. Further research is needed to explore the effectiveness of such interventions when delivered by different members of the health care team. Greater flexibility in delivery may reduce some of the limitations associated with group-based delivery, such as staff time, resources, and general organisation. Finally, insight is required from both staff and participants on their experiences of group-based education. In particular, it is important to determine how participants perceive multiple lifestyle behaviour change in comparison with physical activity only behaviour change.

2.5.1.5 Structured physical activity training approaches

Structured physical activity training is a term used to describe physical activity sessions which incorporate prescribed activities and intensities. Structured sessions aim to address the current physical activity guidelines for adults with Type 2 diabetes by including aerobic activity, resistance training activity and flexibility (Umpierre et al., 2011). Supervised structured physical activity training has been shown to increase levels of physical activity and promote health benefits in adults with Type 2 diabetes (Balducci et al., 2012; Umpierre et al., 2011).

The effect of structured physical activity sessions in adults with Type 2 diabetes has been reported in a systematic review and meta-analysis by Umpierre et al (2011) (Table 2.11). Of the 47 studies included, 23 studies (n=1533) evaluated the effect of structured physical activity training. Meta-analysis found that structured training significantly reduced HbA1c when compared with control groups. Furthermore, structured sessions of greater than 150-min per week were associated with significantly greater changes in HbA1c, compared with sessions of less than 150-mins per week.

The remaining 24 studies (n=7025) compared the effect of physical activity advice, which also reported a significant reduction in HbA1C compared with control groups. It should be noted, however, that studies included in the ‘physical activity advice’ meta-analysis covered a variety of methods making comparison of the interventions difficult.

Table 2.10. Summary characteristics of studies using group-based approaches

Author *Country*	*Design & Aim* *Theoretical Framework*	*Participants*	*Duration*	*Intervention & Outcomes*	*Findings*
Davies et al, 2008 *UK* *The DESMOND Study*	Multi-centre RCT Aim: to evaluate the effectiveness of a structured group education programme on biomedical, psychosocial, and lifestyle measures in newly diagnosed T2D Theory: combined (CST, DPT, SLT)	N=824 45% female Age: 59.5yrs (SD not reported)	6-hours Follow-up: 4, 8 & 12-months	Control group: received usual care using 'enhanced' resources to match those of the intervention group. Intervention group: received a 6-hour structured group education session, delivered in 1-day or two half days. Delivered by health care educators Outcome measures: HbA1c, weight, 10-yr CV risk, PA (IPAQ), and other psychosocial outcomes	At 12-month follow-up: Non-significant decrease in HbA1c in the intervention and control group (-1.49% & -1.21% respectively, *P*=0.52). Intervention group, when compared with the control group, showed significantly greater weight loss (-2.98kg versus -1.86kg, *P*=0.027); significantly lower 10-year CV risk (10.9% versus 13.6%, *P*<0.002); significantly greater illness belief scores (*P*<0.001); and significantly lower depression scores (*P*=0.032). No significant between-group difference was found for change in PA at 12-months, however, this was significantly greater in the in the intervention group at 4-months (*P*=0.046)

De Greef et al, 2010 *Belgium*	RCT Aim: to investigate the benefits of a pedometer and behavioural group intervention for promoting PA Theory: combined (CBT, SCT, TTM, MI)	N=41 31.7% female Mean age: 35-75yrs (SD not reported)	3-months Follow-up: 3 & 12-months	Control group: standard care of one single group-education session. Intervention group: five 90-min group educations over 12 weeks, a booster session after 22 weeks and a pedometer. Delivered by health post-graduates Outcome measures: PA (accelerometer & pedometer), weight, HbA1c and multiple health outcomes	At 12-week follow-up: Intervention group had significantly increased their steps per day compared with control group (2502 versus 324 steps; $P<0.05$). Intervention group significantly reduced their sedentary behaviour by 1-hour per day ($P<0.05$). There was no significant effect on total PA or health outcomes. At 12-month follow-up: Intervention group maintained a significant trend for greater steps per day than the control group (924 versus -864 steps, $P=0.1$). Sedentary activity returned to baseline levels
De Greef et al, 2011 *Belgium*	RCT Aim: to compare effectiveness of a 12-week PA intervention via individual consultation or group delivery	N=67 30% female Mean age: 67.4 ± 9.3yrs	12-weeks Follow-up: 12-weeks	Three treatment arms (Group A-C). Group A: received three individual PAC by GP. Group B: received three PA group counselling sessions by a clinical psychologist. Group C: control group, received no intervention Outcome measures: steps per day	At 12-week follow-up: Group B significantly increased their steps per day compared with Group A and Group C (1706 versus 837 versus 313 steps, $P<0.05$). Group B significantly increased their self-reported PA by 82mins per day compared with Group C who reported a decrease of 21mins per

	Theory: combined (CBT, TTM, SCT, MI)			(pedometer), PA (IPAQ) and multiple health outcomes	day (*P*<0.05). Only Group B showed a significant improvement in health outcomes (*P*</=0.05)
Diedrich, Munroe & Romano, 2010 *USA*	RCT Aim: to evaluate the effectiveness of a self-help PA program for T2D Theory: not reported	N=53 66% female Age:54.2yrs (23-89yrs)	12-weeks Follow-up: 12-weeks	Control group: received standard diabetes group education of 8-hours. Intervention group: same as control group in addition to a walking handbook and pedometer Outcome measures: PA (Paffenburger questionnaire), HbA1c, BP, weight and % body fat	At 12-week follow-up: Both the intervention and control group increased their level of PA (42 versus 35mins per week) with only the pedometer group showing a significant increase in daily steps (2340 steps per day, *P*=0.01). A significant improvement in HbA1c and weight was observed in both groups
Vadstrup et al, 2009 & 2011 *Denmark* *The Copenhagen Project*	RCT Aim: to evaluate effectiveness of a lifestyle group-based intervention compared with individual counselling Theory: not reported	N=143 41% female Age: 58 ± 10yrs	6-months Follow-up: 6, 12 & 24-months	Control group: received individual monthly consultations for 4-months by a diabetes nurse specialist. Intervention group: received three blocks of group education covering diabetes care (6-weeks), diet (3-sessions) and physical activity (12-weeks). Delivered by multiple health professionals	At 6-month follow-up: Control group, when compared with the intervention group, significantly improved HbA1c (-0.6% versus -0.3%, *P*=0.03) and fasting blood glucose (-1.2 versus -0.4mmol/l, *P*=0.02). Both groups significantly reduced their weight, waist circumference, SBP, DBP and TC (*P*<0.05). Findings from 12 & 24-

				Outcome measures: HbA1c, 6-min walk test, muscular strength, multiple health outcomes	month follow-up have not yet been published
Wadden et al, 2009 & 2011 *USA* *The Look AHEAD trial*	Multi-centre RCT Aim: to achieve >5% weight loss via a group-based diet and PA intervention Theory: not reported	N=5145 60% female Age: 59±6.8yrs	4-years Follow-up: 1, 4 & 12-years	Control group: received standard diabetes education of 3-4 education sessions per year in years 1-4. Intervention group received an intensive DPP-based lifestyle programme incorporating weekly sessions in year 1, 2 sessions per month in years 2-3 and monthly sessions in year 4. Delivered by a dietitian, clinical psychologist and exercise physiologist Outcome measures: % weight loss	At 1-year follow-up: Intervention group showed greater weight loss compared with control group (8.6% vs 0.7%, $P<0.001$). At 4-year follow-up: Intervention group showed greater weight loss compared with control group (4.7% vs 1.2%, $P<0.0001$). Greater number of intervention participants achieved >5% and >10% weight loss than the control group (46% vs 25% and 23% vs 10% respectively, $P<0.0001$)

Abbreviations. CST: Leventhal's Common Sense Theory, DPT: Dual Process Theory, SLT: Social Learning Theory, CBT: cognitive behavioural therapy, MI: motivational interviewing, SCT: Social Cognitive Theory, TTM: Transtheoretical Model of Change, PA: physical activity, IPAQ: International Physical Activity Questionnaire, SBP: systolic blood pressure, DBP: diastolic blood pressure, TC: total cholesterol, DPP: Diabetes Prevention Program

Confounding factors included: theory-based versus non-theory-based interventions, group versus individual delivery of information, and delivery within various settings. In general, findings should be interpreted with caution due to 16 of the 47 studies also providing dietary advice to participants. The role of a structured physical activity training approach was further supported by the *Italian Diabetes Exercise Study* (IDES) (Balducci et al., 2008). Results at 12-months found that supervised physical activity, in combination with physical activity consultation, was greater than physical activity consultation alone in promoting levels of physical activity, reducing HbA1c and improving cardiovascular risk profile (Balducci et al., 2012) (Table 2.11).

There is no indication in the methods regarding any *maintenance* strategies used in the supervised physical activity sessions. Maintenance strategies are a standard component of physical activity behaviour change, required to sustain long-term effectiveness (Fjeldsoe, Neuhaus, Winkler, & Eakin, 2011; Greaves et al., 2011; Muller-Riemenschneider, Reinhold, Nocon, & Willich, 2008).

A small study, comparing prescribed physical activity training in a supervised versus unsupervised setting reported interesting results (Taylor, Fletcher, & Tiarks, 2009) (Table 2.11). At 2-month follow-up no significant between group differences were found for any outcome measure, suggesting that participants who were encouraged to follow an unsupervised prescribed physical activity programme achieved similar results to participants in a supervised environment (Table 2.6). This study was limited by a small sample size and lack of additional measures to assess total levels of physical activity. Long-term follow-up would have added insight regarding the on-going effectiveness of supervised and unsupervised physical activity. Similar to other structured physical activity studies, limited reference was made to theory-based strategies of behaviour change.

A major limitation of structured physical activity training is that methods rarely employ or report theory-based behaviour change strategies. As outlined at the beginning of this chapter, physical activity interventions based on theoretical models of behaviour change and employing standard behaviour change techniques (i.e. goal-setting, self-efficacy, social support, decisional balance etc.) are more effective at promoting lifestyle change than non-theory based interventions.

Structured physical activity training programmes have been shown to be effective in increasing levels of physical activity, in addition to achieving significant health outcomes in people with Type 2 diabetes. A major strength of structured physical activity training is that individuals are provided with a programme that often meets (or exceeds) the recommended physical activity guidelines for Type 2 diabetes. Therefore, in theory, adherence to a structured programme *should* result in positive health outcomes. However, limitations are associated with this structured approach. Firstly, the majority of studies do not report any theory-based approaches to behaviour change, and few strategies are outlined to promote lifestyle change out with participation of the structured programme. No studies reported any maintenance strategies for participants following the end of the structured programme. In particular, it may not be feasible for participants to remain in structured physical activity sessions indefinitely. Therefore, the use of behaviour change strategies to maintain positive physical activity behaviour out with structured sessions is essential. Without appropriate use of maintenance strategies it may be proposed that this type of intervention is unsustainable long-term. Finally, a lack of long-term follow-up data makes it challenging to determine the overall effectiveness of structured training.

Research gaps in the structured physical activity literature

Several gaps in the literature exist for structured physical activity training. Most importantly, no studies explore the behaviour change of people with Type 2 diabetes once they have completed a structured physical activity intervention. In addition, it is essential to explore the experiences of participants who have gone from a structured (and often supervised) approach to an unstructured post-intervention lifestyle. It is important to determine whether participants were willing or able to continue with physical activity once the supervised and structured sessions were no longer available. This information would aid the development of maintenance strategies for future interventions.

Table 2.11. Summary characteristics of studies using structured physical activity approaches

Author *Country*	*Design & Aim* *Theoretical Framework*	*Participants*	*Duration*	*Intervention & Outcomes*	*Findings*
Balducci et al, 2008, 2010 & 2012 *Italy* *The Italian Diabetes and Exercise Study (IDES)*	Multi-centre RCT Aim: to improve glycaemic control via structured PA participation. Theory: combined (SET, SCT & TPB)	N=606 42.1% female Age: 58.8±8.6yrs	12-months Follow-up: 12-months	Control group: standard care of physical activity counselling every 3-months for 12-months. Intervention group: two 75-min structured & supervised PA sessions per week in addition to standard care Outcome measures: HbA1c, VO2max, CV risk profile, levels of unsupervised PA	At 12-month follow-up: Intervention group showed significantly greater reduction in HbA1c compared with the control group (0.42% vs 0.13%, *P*<0.001). Intervention group also showed significantly greater changes in levels of PA, VO2max, and CV risk profile (*P*<0.001) compared with control group. Control group showed significant improvements from baseline in levels of PA, fasting blood glucose, VO2max, SBP, DBP, LDL cholesterol and waist circumference (*P*<0.001)

Taylor, Fletcher & Tiarks, 2009 *USA*	RCT Aim: to compare supervised versus unsupervised structured PA participation Theory: not reported	N=24 50% female Age: 55.1±7.7yrs	2-months Follow-up: 2-months	Control Group: received a PAC and a structured PA programme to perform unsupervised at a local leisure facility. Intervention Group: same as control group but PA programme was supervised in a laboratory setting Outcome measures: CV capacity, upper and lower body strength	At 2-month follow-up: No significant between-group difference was found in CV capacity or upper or lower body strength
Umpierre et al, 2011	Systematic review of RCTs Aim: to evaluate the ability of structured exercise training lower HbA1c in adults with T2D Theory: not reported	23 RCTs (N=1533) % female not reported Mean age: ranged from 52 to 69yrs	12-weeks minimum duration	Comparative analysis of RCTs of at least 12-weeks duration that compared structured exercise training with a non-exercise control group Outcome measures: HbA1c	Structured exercise training was associated with a decline in HbA1c level (-0.67%; 95% CI, -0.84% to -0.49%; *P*<0.001) compared with control participants. In addition, structured aerobic exercise (-0.73%; 95% CI, -1.06% to -0.40%; *P*<0.001), structured resistance training (-0.57%; 95% CI, -1.14% to -0.01%; *P*<0.001), and both combined (-0.51%; 95% CI, -0.79% to -0.23%; *P*<0.001) were each associated with declines in HbA1c levels compared with control participants. Structured exercise

					durations of more than 150 minutes per week were associated with HbA1c reductions of 0.89% (*P*<0.001), while structured exercise durations of 150 minutes or less per week were associated with HbA1c reductions of 0.36% (*P*<0.001)

Abbreviations. SET: Social Ecological Theory, SCT: Social Cognitive Theory, TPB: Theory of Planned Behaviour, PA: physical activity, SBP: systolic blood pressure, DBP: diastolic blood pressure, LDL: low density lipoprotein cholesterol.

2.5.2 Summary of research findings

A strong and growing evidence base exists to support the use of theory-based physical activity interventions within the diabetes population. Significant outcomes have been reported from many studies employing recommended behaviour change techniques such as those suggested by Michie et al (2011). These have been delivered using a variety of methods, including: physical activity consultation, telephone-delivered interventions, pedometer-based and group-based interventions, or structured physical activity training. In general, findings show that interventions tailored to the individual have greater success than general physical activity interventions. Despite many positive findings, some studies have found no significant change following physical activity intervention. The majority of these studies have, however, acknowledged their limitations, which typically include: a small sample size, recruitment of active individuals, lack of maintenance strategies, lack of long-term follow-up and lack of assessment of protocol fidelity. The majority of studies included in this discussion of the literature focussed on the clinical and health benefits of physical activity.

Strengths and limitations are associated with each intervention approach. For example:

- Moderately inexpensive, and simple to deliver, methods include the promotion of physical activity via mail, telephone and pedometers. However, mixed findings support their effectiveness long-term.
- Group-based interventions, and some structured physical activity programmes, promote social support, peer-motivation and exchange of experiences. Greater insight is required from participants to understand the impact of such interventions.
- Face-to-face consultation offers participants a highly tailored intervention, which may particularly benefit people with Type 2 diabetes who require greater support. While they have been shown to be effective, consultations

typically have duration of 30-mins. This is resource-intensive and may limit widespread implementation in practice.

Several gaps have been highlighted in the physical activity and Type 2 diabetes literature. These will be addressed in greater detail below in relation to the PhD research questions. Briefly, however, identified gaps include a lack of:

- Interventions with long-term follow-up (>12-months).
- Information regarding strategies to promote the *maintenance* of behaviour change.
- Appropriate recruitment strategies to target individuals who are inactive.
- Appropriate adherence strategies to retain participations with the lowest levels of activity.
- Information on the behaviour change training of staff delivering interventions
- Assessment of fidelity to intervention protocols.
- Qualitative insight from participants and staff regarding the their experiences of giving/receiving physical activity information.
- Discussion on the psychological benefits associated with physical activity for individuals with Type 2 diabetes.

2.6 The progress of diabetes prevention research

Although the focus of this PhD is on the *management* of Type 2 diabetes, it is also important to discuss the role of physical activity in the *prevention* of Type 2 diabetes. The translational work undertaken on diabetes prevention demonstrates what can be achieved in the related field of diabetes management. A brief overview of diabetes prevention's journey from efficacy research to widespread adoption is therefore provided, with the purpose of demonstrating the end-goal for researchers involved in diabetes management.

Diabetes prevention research has progressed rapidly throughout the past decade. Initial efficacy findings were published in the early 2000's, followed by extensive research on the effectiveness of such intervention in various settings, ethnic groups etc. Research findings have since been interpreted, translated, implemented and evaluated in a wide variety of settings. As a result, diabetes prevention programmes are now widely implemented within routine health care.

2.6.1 Research Findings

It is not within the scope of this thesis to extensively discuss the findings of diabetes prevention research. It is, however, important to highlight the main efficacy findings, and how, by the process of translation, these have been implemented as effective interventions in everyday practice.

Several diabetes prevention studies have contributed significantly to the evidence-base. These include the Diabetes Prevention Program (The Diabetes Prevention Program Research Group, 2002), Finnish Diabetes Prevention Study (Lindström et al., 2012), and the Da Qing study (Pan, Li, Hu, & et al, 1997). Consistent findings have demonstrated that lifestyle interventions can significantly reduce the risk of developing Type 2 diabetes by 31-58%. Furthermore, follow-up studies have reported that reduced diabetes risk can be maintained long-term (Diabetes Prevention Program Research Group, 2009; Lindström et al., 2012).

The Diabetes Prevention Program (DPP) is perhaps one of the most well-known and longest running interventions (since 1996). On-going results have been widely published, offering extensive insight into the development and implementation of interventions for individuals at high risk of developing Type 2 diabetes (Kriska et al., 2006; Ratner et al., 2012).

The DPP (Diabetes Prevention Program, 1996) was a large multi-centre study aimed to compare the effect of a lifestyle intervention with pharmacological treatment on the incidence of Type 2 diabetes. Participants (n=3234) were randomised to one of three groups; lifestyle versus pharmacological versus placebo. The lifestyle intervention group received an initial 6-month education programme aimed at achieving a minimum of 150-min per week of moderate intensity physical activity, and a minimum of 7% weight loss. Education was delivered to individuals in a 16-session format by a 'lifestyle coach' (primarily dieticians). Participants subsequently received a 6-month maintenance phase, where they continued to receive monthly contact (telephone or face-to-face). The maintenance phase was less structured, with participants choosing to attend numerous opportunities for additional group education lessons, individual consultations or supervised physical activity classes. Theory-based behaviour change strategies guided all stages of the DPP protocol. Participants in the pharmacological group were prescribed metformin; an anti-hyperglycaemic drug of the biguanide group. Finally, participants in the placebo group were prescribed an inactive tablet. Both the metformin and placebo group were blind to their allocation.

At 3-year follow-up, participants receiving the lifestyle intervention were found to have significantly reduced their risk of developing Type 2 diabetes by 58%, compared with 38% in the metformin group. Furthermore, a recent long-term follow-up demonstrated that individuals who had received the lifestyle intervention continued to have a 34% reduction in diabetes risk at 10-years, compared with 18% in the metformin group.

As mentioned above, these findings are consistent with those of other studies, in particular, the Finnish Diabetes Prevention Study (DPS) (n=522), who also found lifestyle intervention participants maintained a reduced risk of Type 2 diabetes at 13-year follow-up (Lindström et al., 2003; Lindström et al., 2012). The 8-month DPS protocol aimed to achieve five lifestyle goals via group-education, including:

- minimum of 5% weight loss
- minimum of 240-mins of moderate intensity physical activity per week
- minimum of 15g of fibre/1,000kcal

– less than 30% of total energy intake form fat
– less than 10% total intake from saturated fat.

Follow-up results at 12-months demonstrated that achieving 4 of the 5 lifestyle goals was sufficient to prevent Type 2 diabetes, with significant reduced risk being demonstrated at 13-year follow-up.

A strength of the DPP and the DPS was the development of an intervention protocol that addressed the large multi-centre nature of the trial. Effective strategies were required to facilitate effective organisation, delivery, and data collection for the intervention. As a result, the research teams produced an in-depth manual, in addition to several informative peer-reviewed publications detailing the development and implementation of the intervention in practice (Diabetes Prevention Program, 1996; Finnish Diabetes Association, 2003; Lindström et al., 2003).

For example, the DPP described in detail eight key steps in the implementation of the study. These included:

- the appointment of ‘lifestyle coaches’ for individual participants
- frequent and on-going contact with participants
- delivery of a 6-month structured evidence-based education programme
- delivery of a 6-month flexible maintenance phase
- ‘individualisation’ using appropriate adherence strategies
- provision of supervised physical activity sessions
- tailoring of resources and programme components for diverse ethnic groups
- and utilising an extensive network of clinical support, training and feedback.

Dissemination of such in-depth information has helped fellow researchers interpret the DPP and DPS findings and to develop translational studies to implement into everyday practice. Publication of findings by other studies has continued to include a high level of practical and useful information (Katula et al., 2009; Ruggiero, Castillo, Quinn, & Hochwert, 2012). Perhaps the DPP and DPS publications provided a template for the standard of reporting in lifestyle intervention research.

Consequently, a large number of studies have applied the DPP and DPS protocols in their own research. Many of these studies have continued to explore the effect of lifestyle interventions within the ‘general’ high-risk population (Ackermann, Finch, Brizendine, Zhou, & Marrero, 2008; Yank et al., 2012); but interestingly, a high number of studies have translated the DPP for a range of other settings and populations, including: postpartum women (Rosal & al, 2011), mental illness (Schneider et al., 2011), youth (Vivian, 2012), family (Kutob, Perez-Siwik, Larez, Aickin, & Ritenbaugh, 2012), and ethnicity (Jaber, Brown, Pinelli, & Herman, 2009).

2.6.2 Translation of diabetes prevention research findings into everyday practice

The translation of diabetes prevention programmes has progressed rapidly in the last few years, with many studies implementing protocols from the DPP and DPS. Publications associated with these translated interventions have continued to provide detail regarding the process of implementation. Many publications have addressed components of the RE-AIM framework (Reach, Effectiveness, Adoption, Implementation and Maintenance).

Of particular note is the GOAL Implementation Trial; a lifestyle intervention translated from the DPS for implementation into everyday practice. The GOAL study has since published several informative articles, each leading with the title, *Diabetes Prevention in the “Real World”* (Abestz et al., 2009; Absetz et al., 2007). These publications addressed the RE-AIM framework and provided insight into how the efficacy findings and research protocol of the DPS translated into everyday practice.

The GOAL Study translated the DPS for implementation within a primary care setting, using existing health care staff. Participants identified as high-risk of developing Type 2 diabetes were offered the 8-month lifestyle intervention. Outcome measures were collected by the GOAL study for comparison with original findings.

Multiple process measures were also collected to evaluate the implementation of the intervention in everyday practice.

The original DPS demonstrated that achieving 4 of the 5 lifestyle goals was effective in preventing the development of Type 2 diabetes. Results from the GOAL study found that 20% of participants (n=70 of 352) had achieved at least four of the lifestyle goals at 1-year follow-up, with risk of diabetes decreasing in relation to the number of lifestyle goals achieved. Further follow-up demonstrated that significant reduction in risk factors was maintained at 3-years. Overall, this was consistent with findings from the DPS, however, weight loss and physical activity goals were achieved significantly less than the DPS. These positive findings suggest that interventions for people at high risk of Type 2 diabetes can be effective and feasible in everyday practice.

Importantly, the GOAL study also reported findings related to their evaluation of the intervention. Evaluation findings demonstrated:

- unemployed people were most likely to drop-out
- attendance was >90% until the final session, which reduced to 81%
- a high level of adoption was found within primary care centres
- achievement of the physical activity goal was the most challenging for participants
- and delivery of the intervention was performed mainly by public health nurses.

These evaluation findings provide useful insight into the challenges of implementation in everyday practice. For example, future adaptation of the GOAL study could incorporate retention strategies for unemployed participants, or greater support for individuals to achieve physical activity goals.

An extensive range of translated prevention programmes has built on the findings of previous efficacy studies. Consequently, a strong evidence base exists for the role of lifestyle change in diabetes prevention. Several guidelines have since been published to aid the translation and implementation of prevention research into practice. These include:

- The *European Evidence-based Guideline for the Prevention of Type 2 Diabetes* (Paulweber et al., 2010).
- The National Institute for Clinical Excellence's *Preventing Type 2 Diabetes: Population and Community Interventions* (2011b).
- The *IMAGE Toolkit to Prevent Type 2 Diabetes in Europe* (Lindstrom et al., 2010).

The IMAGE Toolkit provides the most comprehensive guide to the development, implementation, and evaluation of diabetes prevention programmes in everyday practice. The toolkit presents a step-by-step checklist to support health care services to establish effective and sustainable diabetes prevention services. In addition to providing usable templates and resources, some of the key aspects of the IMAGE Toolkit include information related to:

- utilising key partners in society to promote consistent information (e.g. workplaces, restaurants, schools, sports clubs)
- employing multidisciplinary teams from medicine, behaviour change, nutrition, and physical activity
- establish effective networking with advocacy and marketing skills
- budget planning to establish realistic financial constraints.
- using appropriate methods to identify people at high risk of type 2 diabetes
- employing strategies to encourage participation in intervention activities
- utilising effective theory-based behaviour change strategies.
- setting realistic timeframes for conducting interventions.
- ensuring robust evaluation and quality assurance is performed.
- tailoring of resources and procedures to cater for specialist groups.

It is clear from the preceding literature review that this level of information is lacking for diabetes management.

We have discussed how diabetes prevention research has progressed rapidly in recent years. Large efficacy studies, such as the DPP and DPS, provided the first robust evidence that lifestyle interventions could reduce the risk of developing Type 2 diabetes in high risk individuals. Findings from these studies were reported in great detail, allowing fellow researchers to replicate the interventions with ease. Dissemination of research findings continued to report details of both outcomes and implementation, further supporting the translation of prevention programmes for a variety of settings and population groups. As a result of this extensive evidence-base, diabetes prevention programmes are now frequently implemented within the routine health care of many countries (Whittemore, 2011). Important lessons can be learned from the successful translation of diabetes prevention to support the on-going progress of research addressing diabetes management.

2.7 The need for translational research in diabetes management

Chapter 1 presented a multistage process of translation for health interventions. In relation to physical activity and the management of Type 2 diabetes, the end product of such a process would be the widespread adoption of an effective evidence-based physical activity intervention (Chapter 1, Figure 1.1).

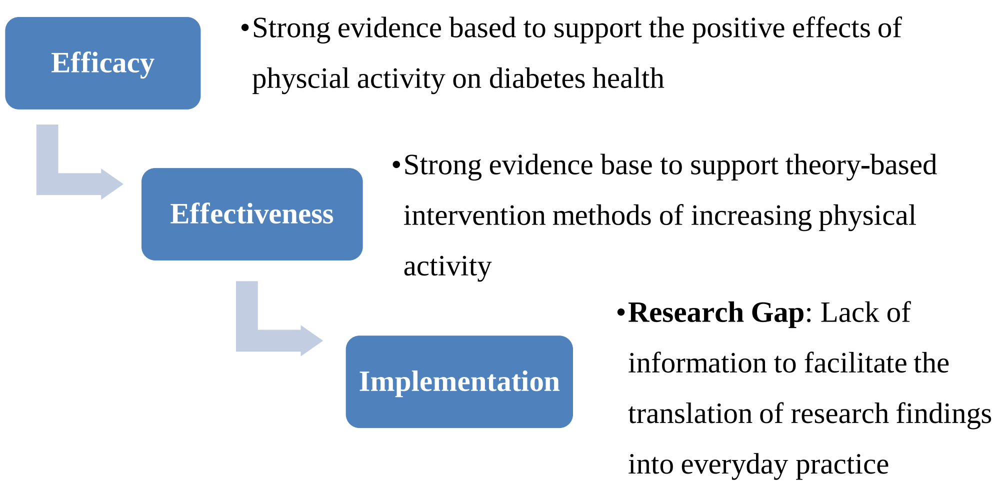
To date, several stages of this multi-stage process have successfully been undertaken. Firstly, controlled studies investigated the effect of physical activity on diabetes outcomes. These initial efficacy interventions measured the effect of multiple factors, such as; intensity, frequency, duration, and type of physical activity (Sigal et al., 2006; Thomas et al., 2006). Conclusive findings showed that physical activity, performed at a moderate intensity, for 30-mins on most days of the week, was effective in improving diabetes outcomes.

Once the efficacy of physical activity had been established, research evolved into a second stage where studies explored the effectiveness of various methods available to support people with Type 2 diabetes to meet these recommendations. Findings have shown that interventions, based on theoretical models of behaviour change, and tailored to the individual needs of people with Type 2 diabetes, can be effective in achieving sufficient levels of physical activity.

Information to support the next stage of translation into everyday practice is now needed (Figure 2.3). However, there is a lack of *useful* information presented in published papers; which typically focus solely on outcome results. In a recent review of 80 health interventions for the BMJ, Glasziou et al (2010) found that 50% did not report sufficient information to enable the intervention to be effectively replicated. In addition, only 31% reported on fidelity to the intervention protocol. As previously mentioned, assessment of fidelity is crucial to allow fellow researchers to interpret findings and adapt protocols for replication:

- "Few intervention studies discuss details of how they translate theory into practice or how they integrate different modalities and collaborating institutions, but such integration is critical for project success" (Gaglio et al., 2010, p. 1)

Figure 2.3. The multi-stage process of translation for physical activity interventions in Type 2 diabetes. (Created by Matthews based on findings from the literature review)



In general, publications often lack information on: recruitment, adherence, fidelity, staff training, resources, administration, and qualitative insight from participants and staff. This type of information is essential for other researchers to effectively translate physical activity interventions for diabetes care. We have already highlighted the lack of such information throughout the literature review.

As recommended by Estabrooks and Glasgow (2006), future interventions require development with a focus on transferring effective physical activity promotion methods to everyday practice. The Medical Research Council framework provides guidance on the stages of progressing theoretical and exploratory research findings into effective interventions suitable for long-term implementation (Medical Research Council, 2008). The process of translating research findings into practice can be supported by the RE-AIM framework. Resources are available from the RE-AIM website to facilitate both the *development* of interventions for practice, and the *evaluation* of interventions post-implementation. These resources encourage researchers to address the components of Reach, Effectiveness, Adoption, Implementation, and Maintenance. Furthermore, the complex process of implementation often requires greater in-depth evaluation. In these circumstances, the role of Process Evaluation is important, as recommended by the World Health Organisation (2000) and the Medical Research Council (2008).

Finally, it is encouraging to note that the vital role of translational research has been acknowledged more recently within the research community. Several academic journals now focus on this field of research, including *Translational Behavioural Medicine* and *Implementation Science.* However, while several systematic reviews now exist for the implementation of diabetes *prevention* programmes, very few studies have presented findings on the *management* of Type 2 diabetes (Matthews, Kirk, et al., 2013). The brief section discussing the role of physical activity in diabetes prevention highlighted the successful processes of wide-spread implementation that have occurred since the initial publication of efficacy studies in the early 2000’s. The progress made in the field of physical activity for people at high risk of Type 2 diabetes should inspire and motivate researchers to achieve the same success in people already diagnosed with Type 2 diabetes.

Overall, Chapter 2 revealed that despite strong evidence to support the role of physical activity behaviour change in the management of Type 2 diabetes the current literature lacks sufficient information to effectively translate and implement interventions into everyday practice.

2.8 Research Questions

The aim of this PhD was to contribute to the translational gaps in the literature concerning physical activity as an element of management of type 2 diabetes by addressing the following research questions:

Research Question 1: What issues are associated with the design, translation and implementation of physical activity interventions for people with Type 2 diabetes in an everyday routine care setting?

- Chapter 3 presents a systematic review of literature exploring the translation and implementation of evidence based physical activity interventions into everyday practice.
- Chapter 5 reports the findings of an in-depth process evaluation of the pilot physical activity intervention service in NHS Grampian.

Research Question 2: What are the views and attitudes of health professionals towards current and future physical activity promotion within routine diabetes care?

- Chapter 4 provides qualitative insight from health professionals regarding their experiences of physical activity promotion, and their thoughts on the future delivery of physical activity promotion with NHS Scotland.

Research Question 3: What are the key elements for effective delivery of physical activity services within routine diabetes care?

- Chapter 6 presents recommendations for the translation, implementation and evaluation of physical activity interventions for people with Type 2 diabetes. Development of these recommendations will be based on findings from Chapter 3- 5.

2.9 Mixed methods approach to PhD research

In order to answer these research questions I have adopted a mixed methods approach. The research conducted for this thesis involves a combination of quantitative, qualitative and evaluative research methods. I aimed to gather a wide range of data to help understand the complex processes of implementation. Mixed methods research is valuable for research questions that are challenging to answer by quantitative or qualitative data alone (Tashakkori & Teddlie, 2003). This approach allowed me to collect numerical data in addition to the qualitative insight needed to interpret the data (Teddlie & Tashakkori, 2009). This thesis benefits from the adoption of mixed methods by being able to present findings from a range of studies including: (1) a systematic review of the literature using the RE-AIM framework, (2) qualitative insight from health professionals using Interpretative Phenomenological Analysis, (3) and an in-depth process evaluation of a physical activity consultation intervention implemented within routine diabetes care. The final recommendations presented in Chapter 6 are therefore collated from a breadth of data.

CHAPTER 3

Paper One

The manuscript presented in Chapter 3 has been published in the peer-reviewed journal, *Translational Behavioral Medicine*. The paper is presented using the structure and reference style of the published article. Tables and figures are included at the end of the manuscript (page 122).

This paper addresses research question 3 by exploring the translation and implementation of evidence based physical activity interventions into routine diabetes care.

Can physical activity interventions for adults with type 2 diabetes be translated into practice settings? A systematic review using the RE-AIM framework.

Lynsay Matthews, Alison Kirk, Freya MacMillan, Nanette Mutrie

ABSTRACT

Despite the strong evidence base for the efficacy of physical activity in the management of type 2 diabetes, a limited number of physical activity interventions have been translated and evaluated in everyday practice. This systematic review aimed to report the findings of studies in which an intervention, containing physical activity promotion as a component, has been delivered within routine diabetes care. A comprehensive search was conducted for articles reporting process data relating to components of the RE-AIM framework; Reach, Effectiveness, Adoption, Implementation and/or Maintenance. Twelve studies met the selection criteria. Of the nine studies which measured physical activity as an outcome, eight reported an increase in physical activity levels, five of which were significant. Tailoring recruitment, resources and intervention delivery to the target population played a positive role, in addition to the use of external organisations and staff training. Many interventions were of short duration and lacked long-term follow-up data. Findings revealed limited and inconsistent reporting of useful process data.

Implications

Policy: Research funding for physical activity in adults with type 2 diabetes should support the translation of interventions focused on *long-term* behavior change and follow-up.

Research: Given the importance of physical activity promotion in the management of type 2 diabetes, further interventions need to be effectively translated, implemented, evaluated, and consistently *reported* to inform future sustainable practice.

Practice: Future physical activity interventions should include partnership with relevant external organisations and staff training, in addition to *tailoring* recruitment, resources and intervention delivery to the target population.

BACKGROUND

Type 2 diabetes is a global health problem, with 387 million individuals (7.0%) estimated to have the condition by the year 2030 [1]. It is therefore essential that effective management strategies are developed to reduce the growing burden of diabetes care.

Physical activity plays a crucial role in the management of type 2 diabetes, with extensive research reporting significant improvements in glycaemic control and diabetes-related complications [2-4]. Moderate increases in physical activity have been shown to reduce HbA1c, and improve insulin sensitivity, fat oxidation and lipid storage in muscle [2].

It is known that physical activity interventions based on a theoretical framework of behaviour change and tailored to the needs of individuals with type 2 diabetes are more effective than general physical activity promotion [5,6]. A 2012 review and meta-analysis by Avery et al found behavioural interventions aimed at increasing physical activity in adults with type 2 diabetes produced significant increases in physical activity in addition to significant improvements in BMI and HbA1c [12]. Guidelines now exist on the development of physical activity interventions for adults with type 2 diabetes [7,8]. These guidelines recommend the use of a valid theoretical framework to structure interventions (i.e Transtheoretical Model of Behaviour Change [9], Social Cognitive Theory [10] and Self-Efficacy Theory [11]) and use of behaviour change techniques such as goal setting, problem solving, self-monitoring and decisional balance.

Efficacy studies of physical activity interventions for adults with diabetes differ in their delivery methods (e.g. group education versus individual counselling), setting (e.g. clinic versus community), and duration/frequency of contact. Several reviews of the literature have explored the effectiveness of these factors with various findings. Significant improvements in glycaemic control are associated with interventions of greater than 6-months duration [12] or where physical activity advice is combined with dietary advice [13]. Significant improvements in levels of physical activity have been demonstrated via the use of one-to-one physical activity consultations [7]. No further associations could be identified from the literature in terms of delivery method or frequency of contact. There is currently no consensus on the optimal method of delivery for physical activity interventions within routine diabetes care.

The majority of this research has been undertaken in a controlled research environment where publications mainly focus on the efficacy outcomes of the intervention [12]. Little is known about how these interventions work once implemented into everyday practice. The methodologies and findings of controlled research studies do not necessarily translate into the context of routine diabetes care. Information regarding the *delivery* of the intervention is essential to understand the processes of implementation and inform the development of future interventions.

The gap between 'what we know' and 'what we do' in health care has been documented by Estabrooks and Glasgow, who noted the lack of translational work being undertaken for clinical populations in relation to physical activity [14]. Various facilitators and barriers contribute to the complexity of intervention delivery within health care. Limited knowledge of departmental processes, staff-turnover, staff commitment and funding have been reported as some of the factors associated with implementation within health care settings [15-17]. Progress is limited further by publications reporting minimal information on the development, delivery and evaluation of their interventions [16,18,19].

The RE-AIM framework is a useful tool to facilitate the development, delivery and evaluation of health interventions [20]. RE-AIM has been frequently used to translate research into practice [21,22] by promoting the development and evaluation of interventions based on the following elements:

- *Reach* of the intervention for the intended target population.
- *Effectiveness* of the intervention in achieving the desired positive outcomes.
- *Adoption* of the intervention by target staff, venues and/or organisations.

- *Implementation*, consistency and adaptation of the intervention protocol in practice.
- *Maintenance* of intervention effects on individuals or settings over time.

The framework also encourages researchers to report the broader issues related to intervention delivery. The RE-AIM framework can therefore play an important role in further strengthening the evidence base for the effectiveness of physical activity interventions for adults with type 2 diabetes.

Physical activity interventions, when delivered for adults with type 2 diabetes in a clinical or community practice context, can be provided in various settings, by various professionals, using various modes of delivery [23,24]. It is possible that all of these approaches result in positive, cost-effective outcomes, but without further evaluation obtaining funding and health service support for physical activity interventions will remain a challenge.

Objective

The aim of this systematic review was not to review efficacy trials of physical activity interventions for adults with diabetes but rather review studies reporting on delivery and implementation of interventions within everyday practice. This review provides important information to improve the translation and implementation of physical activity services within routine diabetes care.

This review adheres to the PRISMA guidelines for the reporting of systematic reviews [25].

METHODS

Data Sources and Searches

There is a low prevalence of articles reporting on issues related to delivery of health interventions, therefore broad search criteria were applied to this review to capture as many relevant articles as possible. To ensure all relevant information was collected, multiple electronic databases were searched (Ovid [MEDLINE; EMBASE], EBSCO [SPORTDiscus; PsycINFO; PsycARTICLES], ProQuest [Australian Education Index; British Education Index; ERIC], ISI Web of Knowledge [Science Citation Index; Conference Proceedings Citation Index], IngentaConnect, Dissertations and Theses, Zetoc, GEOBASE, ScienceDirect, Cochrane Database of Systematic Reviews, Nexis, Informaworld, Google Scholar, NHS e-library, Centre for Review Dissemination, and Cambridge Scientific Abstracts), in addition to sources of grey literature (including health care and government resources, for example, National Institute for Clinical Excellence, National Institutes for Health) [final search conducted May 2012]. The reference lists of key articles and journals were also searched, and correspondence with key researchers in the field was undertaken to highlight any unpublished work in this area. Search terms were developed mainly for use in the MEDLINE and EMBASE databases (see Appendix 1, Table 3.4), and were modified as required for other sources. Key search terms included; physical activity, exercise, diabetes mellitus, health plan implementation, translation, and process evaluation.

The search protocol was discussed within the research team (LM, FMcM, AK & NM) and also reviewed by an experienced subject librarian. The full search was undertaken by one reviewer (LM). Two reviewers (LM, NM) then independently examined titles and abstracts to identify suitable publications matching the selection criteria. Relevant articles were obtained in full and further examined for relevance in the final review collection. The final collection of articles were reviewed and agreed upon within the research team. Any disagreement was resolved by discussion.

Study Selection

All publications discussing the delivery of physical activity promotion for adults with type 2 diabetes were included in the review regardless of type of publication, year, language, study design, population, setting, length of follow up or geographical location. The search protocol was developed as follows using the PICOS framework for systematic reviews [26]:

- *Population*: adults with type 2 diabetes (18^+ years); regardless of time since diagnosis, culture and ethnicity, or current treatment regime (pharmacological versus lifestyle management).
- *Intervention*: interventions promoting physical activity behaviour change for the management of type 2 diabetes; delivered in individual or group settings. The intervention may focus on physical activity alone, or be included with multiple lifestyle change factors such as diet and diabetes self-management.
- *Context:* interventions delivered in clinical or community practice settings; including primary care, diabetes clinics, community facilities or others.
- *Outcomes*: based on the RE-AIM framework for health interventions, outcomes will include discussion of the Reach, Effectiveness, Adoption, Implementation and/or Maintenance of the intervention [20].
- *Study Design*: publications which reported any element of the intervention delivery, including; process evaluations, qualitative studies, randomised controlled trials, longitudinal studies and health service evaluation reports.

The systematic review focused on the management of adults with type 2 diabetes via physical activity behaviour change, therefore, the following exclusion criteria were applied:

- Interventions for children or adolescents with diabetes.
- Physical activity and/or diabetes outcomes only, with no process evaluation reported.
- Implementation of interventions for the prevention of diabetes.
- Behaviour change programmes not addressing physical activity.

Data Extraction and Quality Assessment

Data relating to study characteristics, study quality and intervention delivery was extracted from each article and tabulated. Data extraction was performed by one reviewer (LM) and subsequently reviewed for agreement with one of three additional reviewers (AK, NM, FMcM). Any disagreement was resolved by discussion. All articles were analysed for quality of process data using the Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI-Centre) guidelines for the appraisal of process evaluations [27]. Each article was given two final scores in relation to both the ‘reliability’ and ‘usefulness’ of the information provided. In the event of relevant information being missing, authors were contacted for further information and/or clarification of issues as required.

Data Synthesis and Analysis

The RE-AIM framework formed the main body of analysis, with information being extracted, collated and analysed in relation to the framework headings of Reach, Effectiveness, Adoption, Implementation, and Maintenance.

RESULTS

Articles

Figure 3.1 illustrates the stages of the systematic literature review. A total of 3223 potentially relevant publications were found by electronic database searching, with a further 14 citations found by searching grey literature, the reference lists of key articles, and contacting key authors.

Following application of the exclusion criteria to titles and abstracts, and removal of duplicate publications, a total of 50 articles remained, for which the full text was obtained. The remaining collection was further analysed in-depth and a total of 12 articles, which reported detail relating to the process of intervention delivery, were included in the final analysis [28-39].

Interventions analysed for this review took place worldwide including Europe (17%), Australia (17%) and USA/Canada (67%); for a variety of target populations including low socioeconomic areas (17%), specific ethnic groups (25%) and the general diabetes population (58%).

Table 3.1 provides a collated summary of the 12 studies included in the review and highlights the wide variety of articles in relation to study design, setting, method of delivery and physical activity outcomes. Table 3.2 displays individual study characteristics for each of the 12 articles included in the review along with linking reference number. Individual characteristics related to the RE-AIM framework are presented in Table 3.3 for each of the included studies.

1. Reach

All articles reported sufficient data on the target population to allow basic comparison: 100% reached adults with type 2 diabetes; with a mean age of 61.7 years; of which 65.4% were female. Comparison of other factors including BMI, duration of diabetes and co-morbidities, was not possible due to lack of data. Variation in relation to inclusion criteria was minimal and all interventions successfully recruited suitable participants with type 2 diabetes, with some studies providing data showing successful recruitment of participants from high risk groups (Table 3.3).

Five articles (45.5%) reported on the overall reach of the intervention from which a mean uptake of 63.7% (SD 20.0) was observed. A potential overestimation of the reach of two interventions exists, where the number of ‘eligible participants’ did not reflect the large number of identified eligible participants who were then either unreachable or not interested in the intervention [30,32].

Three studies tailored the intervention to a specific ethnic group, who were identified in each locality as a high risk population (Latino and African American) [31,35,36]. The recruitment methods employed by these interventions specifically targeted the high risk groups with tailored promotional material. All three studies provided reach data, showing uptake rates of 50.3%, 64.8% and 91.3% (Table 3.3). The highest rate of uptake (n=200/219) was observed in the Keyserling et al study, where a combined method of identifying eligible patients from both computerised records and routine physician visits was employed [31]. Other recruitment methods were reported, ranging from community marketing to online advertisements, with several interventions employing a mixture of these approaches. With only 5 papers reporting uptake data, comparison of these factors was difficult.

2. Effectiveness

Nine articles (75.0%) reported on effectiveness of the intervention. Overall physical activity outcome measures and results are presented in Table 3.1, with individual study outcomes further presented in Tables 3.2 and 3.3. It is encouraging to note that of the nine articles reporting on effectiveness, 8 interventions (88.9%) showed an increase in physical activity levels from baseline, of which 5 reported a statistically significant increase ($p<0.05$). The study by Bastiaens et al could not provide physical activity results due to low follow-up numbers [28]. The reason for poor follow-up was not discussed, which is unfortunate because this was one of the few studies with a long follow-up period (18 months). The majority of interventions used self-report measures for physical activity, and included a variety of questionnaires previously used in behaviour change research (Table 3.2).

A range of intervention settings were used throughout the 12 studies (Table 3.1). No trend was apparent in the 5 interventions that showed a significant increase in levels of physical activity. Keyserling et al used a combined approach to setting, where interventions were delivered in both the diabetes clinic and community sites [31]. At 6-month follow-up, when compared with the control group, the diabetes clinic setting showed a significant increase in levels of physical activity (p=.036) whereas the community group (p=.095) were not significantly different from the control group. However, during the following 6 months, only the community group received on-going support which resulted in a significant change in levels of physical activity at 12 months in the community group (p=.019) compared with the clinic group (p=.31) (Table 3.2).

3. Adoption

Minimal information relating to the adoption of interventions by relevant staff and health care organisations was reported. Two exceptions include King et al [32] and Osborne [35], where the authors based both the development and evaluation of their intervention on the RE-AIM framework. Their approach is reflected in the quality and usefulness of the information provided (Table 3.2). Osborne, in particular, reported high adoption by the staff and administrators within the local health care provider. However, the service was not adopted long-term due to a lack of funding.

4. Implementation

Implementation refers to whether an intervention was delivered as intended in relation to protocol fidelity, attendance, attrition, time and cost [20]. Fidelity to intervention protocols was high but reported in only six (50%) articles. Protocol fidelity was measured by a variety of methods including; an observation or data checklist [32,38]; observation of intervention delivery followed by on-going feedback [35]; bi-monthly meetings to discuss intervention issues [33]; and self-evaluation by the individual delivering the intervention [36]. Six studies (50%) in this review reported on attendance, ranging from 44%-100% at all sessions. Six studies (50%) reported a wide range of attrition, ranging from 6%-82.3% at follow-up. Minimal information was provided regarding time and cost of intervention implementation.

Despite only 50% of the studies reporting on the main aspects of implementation, it is also important to note that a wide range of process measures were utilised and reported across all 12 studies. These included session records, focus groups or interviews with staff and patients, and end of session questionnaires (Table 3.2). The information provided by these measures linked well with recommendations made by the authors of the RE-AIM Framework for ways to improve implementation (e.g. staff training, development of resources for implementation, and insight from staff and participants regarding the strengths and limitations of an intervention protocol) [20]. This additional but relevant information is therefore presented below.

a) Intervention Protocols

Many studies identified the need for tailoring the intervention to the specific target population by undertaking extensive preparatory groundwork and/or social marketing. Tailoring involved the use of appropriate language, resources, mode and venue of delivery, and the use of positive role models in relation to either ethnicity [31,35,38] or socio-economic status of the local population [30,37]. The Move More Diabetes programme, in particular, used extensive social marketing in the development of the intervention [37]. As a result, the intervention was based on the views of the service users. This approach may be reflected in the high rate of adoption by local organisations and the sustained and on-going success of the programme to the present day (Table 3.3).

Current guidelines for physical activity behaviour change recommend the use of a theoretical framework, which incorporates behaviour change techniques such as goal setting, identification of barriers and problem solving [7,8]. It is therefore encouraging to observe that 100% of the intervention protocols based their approach on recommended behaviour change methods, with 8 of the interventions (66.7%) specifically mentioning use of either the Transtheoretical Model of Behaviour Change, Self-Efficacy Theory or Social Cognitive Theory [9-11].

A variety of resources were used throughout all studies. These included the development of resources for delivery of the specific intervention (e.g. participants resource packs, pedometer diaries), in addition to resources required for delivery of the overall study (e.g. recruitment protocols for external organisations, staff training manuals). Only one study described the development of resources in detail [38].

A range of staff were responsible for delivery of the interventions (Table 3.1 & 3.2), with behaviour change training being undertaken in 91.7% (n=11) of the studies. Many of the interventions also involved on-going training, support, evaluation and feedback for those staff delivering the programme. Of the nine studies reporting effectiveness eight interventions (88.9%) resulted in increased levels of physical activity, all of which were delivered by a wide range of individuals (research staff, peer counsellors, occupational therapists, and others) who had received behaviour change training (Table 3.2).

There was an interesting mixture of methods used for intervention delivery including group sessions, individual face-to-face, individual telephone, individual online sessions and several interventions which used a combined approach (Table 3.1).

Contact time with participants during the intervention delivery ranged widely from 1.5-24 hours (mean 8.9 hours SD 7.4) and a frequency of contact ranging from 1-18 sessions per participant (mean 8.4 sessions SD 5.2). The majority of interventions were of short duration (1-3 months) and although some showed an increase in levels of physical activity at the end of the intervention, long-term follow-up data was often lacking to show whether the changes were sustained long term. The 1-month intervention by Osborne showed an insignificant trend for increasing levels of physical activity at 3-month follow-up (p=.23) [35]. Staff involved in this intervention reported successful delivery and uptake of information but suggested that participants may have achieved measureable outcomes if the intervention was of longer duration (Table 3.2).

b) *Staff and Participant Insight*

Participant insight, across all 12 interventions, was consistently reported as satisfactory, especially among those attending group sessions [28,33,38]. End of study feedback found that group sessions allowed social interaction, discussion of ideas, help from other adults with diabetes and feelings of not being alone. Group interventions also reported themes of support, motivation and the positive use of peer role models. Participants valued the same person delivering all sessions when possible as this developed greater support and communication.

Participant insight in relation to individual sessions also showed a high level of satisfaction, but was not covered as in-depth as the group sessions, making comparison between the methods of delivery difficult.

Constructive feedback was also reported by staff delivering the interventions, including; the need for established routes of communication when using external organisations to prevent loss of participant follow-up [33]; a need for clearly defined roles and responsibilities within the team [35]; and greater maintenance strategies and follow-up in those interventions of short duration [36].

5. Maintenance

Five interventions (41.7%) catered for long-term maintenance in their development and delivery of the intervention, with a follow-up period ranging from 12-18 months (Table 3.2 & 3.3). Methods included a decrease in both frequency and duration of contact with participants over time, a change in method of delivery (e.g. on-going support via telephone, instead of face-to-face meetings), and a long-term follow-up period.

A recurring theme was the requirement for a network of organisations to be involved in the recruitment, promotion and administration of the intervention. Those studies which involved a network of organisations appeared to achieve greater sustainability when compared to those interventions lacking a network. The on-going Canadian intervention, Move More Diabetes by Richert et al, described in detail the positive effect their network of external organisations had on the success of the intervention, and in particular commented on the time commitment of network staff and the need for recruiting motivated organisations (Table 3.3) [37]. This was further supported by Klug et al, where the development phase of the study invested a significant amount of time ensuring networks were established prior to the delivery of the intervention

(Table 3.2) [33]. The level of adoption by external organisations (e.g. community centres, religious centres, elderly day care centres etc) may therefore play a major role in the long term sustainability of interventions and is a key factor that should be taken on board by other researchers and policy makers who attempt to implement future interventions.

DISCUSSION

Previous systematic reviews have explored the various aspects of physical activity in the management of type 2 diabetes, including; the use of behaviour change techniques [12], web-based interventions [24], and structured physical activity training [13]. However, we know of no systematic review that has explored the delivery of physical activity interventions for the routine management of type 2 diabetes. This paper fills that gap in the literature. Following an extensive search, 12 articles were identified that met the inclusion criteria. Analysis of the articles, using the RE-AIM framework, revealed inconsistent reporting of process data, making analysis and interpretation of overall findings challenging.

Reach

The majority of interventions in this review targeted the general diabetes population, with several interventions targeting low socioeconomic areas or specific ethnic groups. With the exception of three interventions targeting individuals of Latino or African American ethnicity, the remaining studies predominantly recruited participants of Caucasian origin. Individuals from low income and certain ethnic origins are known to have a higher risk of type 2 diabetes and the need to develop effective strategies to address this inequality has been documented [40,41].

Prevalence of diabetes in 2030 is estimated to have increased by 69% in developing countries, compared with 20% for developed countries [1]. Despite this global inequality, all 12 articles included in this review were undertaken in developed countries. Further evaluations are required of the complex challenges of intervention delivery in developing countries.

The identification of eligible participants using practical methods (i.e. computerised records and routine physician visits) was identified by several interventions, including Keyserling et al which reported the highest uptake (n=200/219) [31]. Minimising the use of resource intensive methods for the identification of eligible participants may promote the overall reach of an intervention. This approach is supported by previous research, where the use of electronic records was beneficial in environments where health professionals were under pressure from time constraints and higher priorities [42].

Effectiveness

Positive findings were reported on the effectiveness of interventions included in this review. Nine of the twelve studies reported their outcomes on physical activity levels. Of those studies, eight interventions (88.9%) showed an increase in levels of physical activity from baseline, of which 5 reported a statistically significant increase ($p<0.05$). This is in line with Avery et al where 14 RCT's using self-report physical activity measures reported an overall significant increase in levels of physical activity [12]. Of the five studies in this review that reported significant increases in physical activity the mean intervention duration was 3.4±1.7 months with a mean contact frequency of 8.3±5.3 sessions. In comparison, two of the studies reporting an insignificant trend for increasing physical activity levels were of short duration (4-6 weeks) and involved fewer sessions (range 1-6). A review by Greaves et al identified that the most effective physical activity interventions within the diabetes population were those associated with a greater frequency of participant/counsellor contact [5]. If these interventions had been of longer duration and greater frequency of contact they may have also resulted in significant physical activity outcomes. The 3-arm intervention by Keyserling et al positively showed that significant improvements in physical activity can be achieved in both the clinic and community setting; however, the group who received the greatest frequency of contact over a combined clinic and community setting were the only group to maintain a significant increase at 12-month follow-up. No other associations were found in this review between intervention delivery and effectiveness [31].

Physical activity interventions based on theoretical models of behaviour change have been shown to be more effective than non-theory based interventions [5,43,44]. Guidelines on physical activity for type 2 diabetes recommend the development of physical activity interventions based on a valid theoretical framework [7,8]; therefore, it is positive to note that all 12 interventions adhered to these recommendations.

Eleven of the 12 articles used self-report measures for physical activity. Although not as accurate as objective measures (due to reporting bias), they have been shown to be reliable, inexpensive and practical tools for data collection in practice settings [44]. The exception was the high quality study by Keyserling et al [31]. The results showed a significant increase in levels of physical activity between three comparison groups (p=.014), with a long-term follow-up period, using an objective measure, in the form of accelerometry, and with a large sample size. A comparison with self-report measures would have been useful here to provide insight into the accuracy of participant perceptions of their physical activity behaviour. Care should be taken when choosing outcome measures for interventions in everyday practice. It is important to balance the need for robust measures with the practicalities of collecting data that does not disrupt the participant/counsellor relationship or the time-constraints of the intervention. As identified by Bastiaens et al the burden on staff and resources can be reduced by obtaining data from ‘usual-care’ routes where possible [28].

Adoption

Information regarding adoption of interventions by staff and health services was minimal. The majority of interventions were of short duration with short-term follow-up; it is therefore possible that a time-dependent factor played a role in adoption. This is supported by an evaluation of the ’10,000 Steps’ programme which attempted to implement a widespread walking intervention in Belgium [45]. The authors reported 70% of non-adopting organisations as “not having thought about adoption yet”, and suggest that more organisations would have adopted the programme over time. Pagoto also states that adoption of interventions by health care services does not guarantee sustainability [15]. On-going translation, adaptation and evaluation is required to sustain the continued adoption of effective interventions.

Implementation

Implementation of interventions was inconsistently reported by all 12 articles. Mixed findings for attendance and attrition were provided, with fidelity to the intervention protocol reported in only 50% (n=6) of articles. In a recent review of 80 health interventions for the BMJ, Glasziou et al found that 50% did not report sufficient information to enable the intervention to be effectively replicated. In addition, only 31% reported on fidelity to the intervention protocol [46].

Behaviour change training for staff and peers delivering the intervention was outlined in 11 of 12 articles. Previous research on physical activity interventions has collectively found that health professionals often lack confidence, experience and on-going feedback to promote the use of physical activity [47-49]. The authors of RE-AIM framework suggest that the provision of training and support for individuals delivering interventions may improve protocol fidelity via an atmosphere of collaboration and peer problem solving [20]. In this review, positive outcome measures and high participant satisfaction suggest that a variety of individuals, given appropriate training, can effectively deliver physical activity interventions for adults with type 2 diabetes. Current guidelines for physical activity and diabetes [8] also address this issue, advising that professionals delivering patient centred interventions should receive on-going training. There were inconsistent findings reported by the studies in this review to conclude whether on-going staff training was associated with effectiveness of interventions.

The importance of tailoring recruitment, resources and procedures to the target diabetes population was discussed by several interventions, some of which undertook preparatory social marketing to understand the needs of potential participants. The need for tailoring interventions, in particular for different cultural and ethnic groups, has been highlighted by both the IMAGE Toolkit for diabetes prevention [50] and the Diabetes Prevention Program [51].

Participant feedback was satisfactory across all 12 interventions, with specific positive feedback by those attending group sessions. Other studies have previously reported the benefits of group education, including; peer motivation and support, and a reduced burden on resources by targeting a greater number of participants in a single session [52]. Although specific positive feedback was minimal in this review, individual education sessions have also been identified as an effective method of delivering behaviour change information, in particular for individuals who require additional support [7].

Previous research has highlighted several barriers and facilitators for intervention delivery in practice. These included limited knowledge of departmental processes, staff-turnover, staff commitment and funding [15-17]. Several of the studies included in this review identified similar factors. Two studies discussed the importance staff commitment in relation to the recruitment of external organisations that appeared motivated and willing to cooperate in program fidelity [33,37]. Funding was identified as a barrier to long-term adoption by staff in the study by Osborne [35].

Maintenance

Despite sustainability of health outcomes being a key objective, maintenance of behaviour change was addressed by only 5 (41.7%) interventions. Methodology included decreasing the frequency and duration of contact with participants over time, reducing face-to-face contact, and employing long-term follow-up (ranging from 12-18 months). These methods are in line with the current evidence base, which recommends the incorporation of long-term maintenance strategies to promote sustainable behaviour change [53]. In this review, many interventions were of short duration and lacked long-term follow-up. This issue has also been identified in pedometer-based interventions for adults with type 2 diabetes, where a lack of follow-up data limits our understanding of the short term improvements in walking activity [54-56].

The use of external organisations in the on-going recruitment, promotion and administration of an intervention appeared to play a positive role in the sustainability of several studies. These findings are supported by Goode et al, who discussed the critical role of community organisations in the delivery and sustainability of a telephone delivered lifestyle change intervention [57]. Organisations were involved in the on-going adaptation of the intervention to ensure continued suitability for the target population, in addition to on-going support of health professionals involved in the intervention delivery. The use of external organisations to support adoption and sustainability has also been recommended by other studies exploring the implementation of physical activity programmes [58,59].

Despite the varied and inconsistent information provided by the 12 articles, this review has identified a number of important points for consideration when developing physical activity interventions for delivery in everyday practice.

(1) Reach: The use of computerised records, external organisations and tailored recruitment may help to maximise intervention reach and uptake. Future publications should report accurate information on the reach of the intervention to illustrate full effectiveness.

(2) Effectiveness: Positive findings indicate that in a practice setting, adults with type 2 diabetes can increase their levels of physical activity. A variety of methods can be used to gain positive physical activity behaviour change, including; diabetes clinic, telephone or community settings; individual or group counselling sessions; and intervention delivery by peers, health professionals or research staff . Adults with type 2 diabetes may respond to interventions differently, therefore, the flexibility of using various approaches tailored to the individual may be beneficial in achieving positive physical activity outcomes. Interventions undertaken in everyday settings face the challenge of gaining accurate data on physical activity levels by quick and

easy methods. Future interventions should also consider collecting outcome data from routine-care routes to minimise disruption in intervention delivery.

(3) *Adoption*: The importance of involving a network of external organisations was highlighted and future interventions should identify and network with motivated and culturally appropriate external organisations to improve levels of intervention adoption.

(4) *Implementation*: Tailoring resources and intervention delivery to the target population appeared to play a positive role in achieving high rates of uptake, participant satisfaction and physical activity outcomes. These findings suggest that future interventions should undertake preparatory social marketing of the local diabetes population to enable interventions to be tailored and implemented effectively.

(5) *Maintenance*: The majority of studies were of short duration (1-3 months) and long-term follow-up data (>12 months) was lacking from many interventions to evaluate whether maintenance strategies were successful in sustaining physical activity behaviour change. Future research should deliver interventions using methods of behaviour change maintenance, and report findings after a long-term follow-up period.

Strengths and Limitations

A strength of this systematic review is the focus on interventions delivered in an everyday practice setting. Previous reviews have reported findings from efficacy studies undertaken in a controlled research environment. This is the first review to focus on the broader aspects of intervention delivery in the context of everyday practice. This is a critical step in the progress of translational research for physical activity interventions in adults with type 2 diabetes. A team of reviewers were involved in the robust selection and data extraction of the articles included in this review, reducing the potential for selection bias.

This review has several potential limitations. Firstly, all included articles were undertaken in developed countries, limiting the generalizability of the overall findings. This is a reflection on the lack of publications reporting process information from interventions undertaken in developing countries. There is a high prevalence of type 2 diabetes in developing countries and publication of evaluation findings is encouraged. Secondly, inconsistent information was reported across all 12 articles, making comparison of some factors difficult. In particular, consistent reporting of reach would have provided greater insight into the characteristics of individuals participating in physical activity interventions within routine diabetes care.

CONCLUSIONS

This systematic review demonstrated that physical activity interventions for adults with type 2 diabetes can be effectively translated into an everyday setting. Positive findings showed that effective interventions can be delivered by a variety of trained staff/peers, in a variety of settings. The use of external organisations, behaviour change training, and tailoring of the intervention to the target population played a positive role. Future interventions, of longer duration, are now required to evaluate the maintenance of behaviour change long-term. Importantly, this systematic review highlights the limited number of publications reporting on the translation of physical activity promotion from research to everyday practice for adults with type 2 diabetes. A varied level of information was reported throughout all 12 articles making comparison of data difficult. We therefore recommend that future publications relating to the translation of evidence into everyday practice use a tool, such as the RE-AIM framework, to report consistent and useful information.

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TABLES AND FIGURES

Figure 3.1. Results of literature search

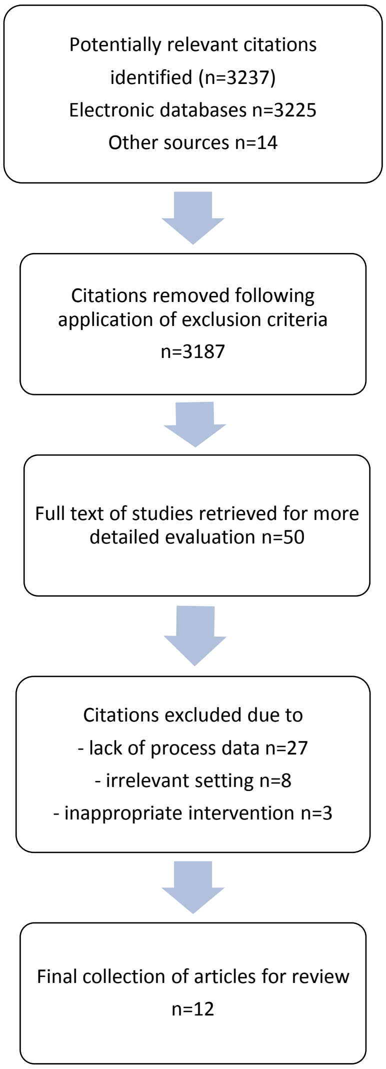

Table 3.1. Collated summary of the 12 studies included in the review [* HP = health professionals; PA = physical activity}

Descriptive Data (range)	Sample size	8-1500 participants	
	Intervention duration	1-12 months	
	Follow-up	1.5-18 months	
	Contact time	1.5-24 hours	
	Contact frequency	1-18 sessions	
Study Design	RCT	5 (41.7%)	
	Process Evaluation	3 (25.0%)	
	Longitudinal	3 (25.0%)	
	Descriptive report	1 (8.3%)	
Main Setting	Community	5 (41.7%)	
	Primary care	4 (33.3%)	
	Diabetes clinic	2 (16.7%)	
	Internet	1 (8.3%)	
Behaviour Change Goal	PA* only	2 (16.7%)	
	PA and diet	3 (25.0%)	
	PA, diet and self management	7 (58.3%)	
Delivery method	Individual	7 (58.3%)	
	Group	4 (33.3%)	
	Both	1 (8.3%)	
Intervention Staff	Mixed group of HP's*	4 (33.3%)	
	Peer counsellors	4 (33.3%)	
	Research staff	2 (16.7%)	
	Other	2 (16.7%)	
PA outcome measures	Self-reported	9 (75.0%)	
	Objective	1 (8.3%)	
	None	2 (16.7%)	
PA results	Significant increase (p<.05)	5 (41.7%)	
	Increase with trend (p>.05)	3 (25.0%)	
	No change	1 (8.3%)	
	Not reported	3 (25.0%)	
Study Quality		*Reliable*	*Useful*
	High	6	8
	Medium	5	4
	Low	1	0

Table 3.2. Individual study characteristics of the 12 studies included in the review

Author	*Reference Number*	*Design*	*Duration / N*	*Intervention*	*PA Measures** / *Process Measures*	*Effectiveness*	*Study Quality*
Bastiaens et al 2009 *Belgium*	21	Longitudinal pilot Goal: PA, diet and self-management Setting: Primary care	3 months Follow-up: 18 months N = 44	Five 2-hr fortnightly group sessions. Additional 3-month follow-up meeting to reinforce maintenance issues. Intervention delivered by various HP’s. Contact time = 12 hours	IPAQ Attendance Data collection Staff support Patient insight	Not reported due to low follow-up numbers	Reliability - Low Usefulness - Medium
Clark et al 2004 *UK*	22	RCT Goal: PA and diet Setting: Clinic	3 months Follow-up: 12 months N = 100	Four 30-minute individual consultations and three 10-minute follow-up phone calls over 12 months. The control group received usual care. Intervention delivered by research staff .	PASE DSCAQ Patient insight	Significantly greater PA levels in intervention group measured by DSCAQ at both 3 and 12 months (p<.001). No significant change in PA levels measured by	Reliability - Medium Usefulness - Medium

				Contact time = 2.5 hours		PASE (p=.087)	
Eakin et al 2008 *Australia*	23	RCT Goal: PA and diet Setting: Primary care via telephone	12 months Follow-up: 18 months N = 434	Eighteen 20-minute telephone calls delivered over 12 months, with decreasing frequency. Patients also provided with home resources including pedometer and resistance band. Control group received usual care. Intervention delivered by staff with health related degree. Contact time = 6 hours	CHAMPS Active Australia Survey Call tracking Content fidelity Cost-effectiveness	Final results not available until 2013	Reliability - High Usefulness - High
Keyserling et al 2002	24	3-armed RCT Goal: PA, diet and	6 months Follow-up:	Group A received four individual counselling sessions by the nutritionist, two group education and multiple personal phone call	Caltrac activity monitor	Significantly greater increase in Group B than C at 6 months (p=.036), however,	Reliability - High

USA		self-management Setting: Primary care/Clinic/Community	12 months N = 200 Females only	consultations by the peer counsellors. Group B received four individual counselling sessions, and Group C received usual care. Intervention delivered by peers and nutritionist. Contact time = (A) 9 hours, (B) 3 hours	Attendance Session duration Number of calls Follow-up participation	significantly greater increase in Group A than C at 12 months (p=.019). Significant overall group effect (p=.014)	Usefulness - Medium
King et al 2006 *USA*	25	RCT Goal: PA, diet and self-management Setting: Primary care	2 months Follow-up: 2 months N = 400	Two tailored 3-hour individual consultations with educator; using computer-assisted behaviour change programme. This group also received tailored phone calls in between the two visits. Control group received usual care. Intervention delivered by various HP's. Contact time = 4 hours	CHAMPS Computer-software usage Patient insight Protocol fidelity	Significantly greater increase in MVPA (p=.001) and resistance training (p<0.001) compared to the control group	Reliability - High Usefulness - High
Klug, Toobert &	26	Longitudinal	4 months	Sixteen weekly 1.5 hour group sessions including education and	SDSCA EBS	Significant increase of PA levels (p = .0248) at	Reliability - High

Fogerty *2008* *USA*		Goal: PA and diet Setting: Community	Follow-up: 8 & 12 months N = 243	peer-focussed feedback on goals, barriers and resources. Protocol amended following initial pilot. Intervention delivered by peers and 'expert lecturer'. Contact time = 24 hours	Attendance Patient insight Peer insight	4-months. Follow-up data not reported due to minimal follow-up participants.	Usefulness - High
McKay et al *2001* *USA*	27	RCT pilot Goal: PA only Setting: Internet	2 months Follow-up: 2 months N= 78	Web-based individual tailored PA programme, including access to behaviour change software, a personal coach and peer-to-peer support area. The control group only had access to diabetes information websites. Intervention delivered by occupational therapist. Contact time = approx 2 hours	BRFSS Participation Webpage usage Patient insight	Significant increase in MVPA and walking in both groups ($p<.001$)	Reliability - Medium Usefulness - High
Osborn *2011*	28	Process Evaluation	1 month	One 90-minute individual culturally tailored education	SDSCA	Insignificant trend for increasing PA levels	Reliability - High

USA		Goal: PA, diet and self-management Setting: Clinic	Follow-up: 3 months N = 118	session. Based on formative focus groups and interviews with potential providers and service users. Intervention delivered by medical assistant/ technician. Contact time = 1.5 hours	Feasibility Cost-analysis Staff insight Patient insight	(p=.23)	Usefulness - High
Plotnikoff et al 2010 *Canada*	29	Longitudinal cohort case studies Goal: PA only Setting: Community via telephone	3 months Follow-up: 3 months N = 8	Twelve weekly telephone calls of 10-15min duration, aimed at increasing both aerobic physical activity and resistance activity. Intervention delivered by peers. Contact time = 2-3 hours	GLTEQ Feasibility Patient insight Peer insight	No significant change in aerobic PA (p=.48) or resistance PA (p=.12)	Reliability - Medium Usefulness High
Richert et al *2007*	30	Descriptive report of community programme.	Flexible and on-going since 2004	A flexible relationship between peers and enrolees. Large-scale social marketing undertaken beforehand to develop the most	Population wide PA levels using BRFSS	Population PA levels showed increasing trend over the initial 2-years of the	Reliability - Medium

USA		Goal: PA & self-management Setting: Community	N = 1500 patient contacts N = 35 peer educators	appropriate service for the community. Recruitment via multiple community resources and established networks. Intervention delivered by peers. Contact time = not reported	Attendance Method of peer support Staff insight Peer insight Recruitment	programme; this has continued to the present day	Usefulness - High
Two-Feathers et al 2007 *USA*	31	Process Evaluation Goal: PA, diet & self-management Setting: Community	5 months Follow-up: none N= 150	Five 2-hour group sessions every 4 weeks, delivered in the community using culturally tailored information. Developed after focus group research with potential service users. Intervention delivered by peers. Contact time = 10 hours	None Attendance Retention Patient insight Peer insight Staff insight	Not reported	Reliability - High Usefulness - High
Unsworth & Slee 2002	32	Process Evaluation Goal: PA, diet and self-management	1.5 months Follow-up: 1.5 months	Six weekly 180-minute group education sessions which the participant could attend alone or with their partner. Intervention delivered by various HP's.	Evaluation questionnaire Attendance Patient insight	Insignificant trend of increasing PA levels	Reliability - Medium Usefulness

Australia		Setting: Community	N = 45	Contact time = 18 hours			- Medium

* (IPAQ) International Physical Activity Questionnaire; (PASE) Physical Activity Scale for the Elderly; (DSCAQ) Diabetes Self-care Activities Questionnaire; (CHAMPS) Community Healthy Activities Model Program for Seniors; (SDSCA) Summary of Diabetes Self-Care Activities questionnaire; (EBS) Stanford Education Research Center Exercise Behaviour Scale; (BRFSS) Behavioural Risk Factor Surveillance System; (GLTEQ) Godin Leisure-Time Exercise Questionnaire.

Table 3.3. Individual RE-AIM characteristics of the 12 studies included in the review

Author	*Reference*	*Reach*	*Effectiveness*	*Adoption*	*Implementation*	*Maintenance*
Bastiaens et al 2009	21	Sample characteristics for ethnicity and income not reported. Barriers were addressed and users involved in the evaluation process. No details of potential local sample	Not reported	Potential for adoption throughout Belgium discussed, due to lack of current service provision	Attendance: 44% attended all 6 sessions. Attrition not reported. Programme developed by team of HP's. Amendments made following pilot study. Staff delivering the programme followed scripts and protocols	Designed with long-term maintenance of behaviour change in mind; moderate duration with follow-up support
Clark et al 2004	22	Not reported	Significantly greater PA levels in intervention group measured by DSCAQ at both 3 and 12 months (p<.001). No significant change in PA levels measured by PASE (p=.087)	Not reported	Attendance not reported. Attrition: 6% (6/100). Patient insight reported and discussed	Long term follow-up and on-going support for the intervention group

Eakin et al 2008	23	72.6% participation of eligible patients (434/598). Challenges reported recruiting minority groups (9%) in addition to low income participants, despite targeting low income areas	Results not available until 2013	Ten primary care sights involved in the study	Results available in 2013. Pilot work on recruitment undertaken prior to the study which informed the main recruitment process	Intervention developed with maintenance in mind, focussing on community supports and sustainability following the end of the intervention
Keyserling et al 2002	24	91.3% participation of eligible patients (200/219). The sample reflected the target population which were African American females, of which 29% had an annual income of <US$10,000	Significantly greater increase in Group B than C at 6 months (p=.036), however, significantly greater increase in Group A than C at 12 months (p=.019). Significant overall group effect (p=.014)	Programme delivered over several health care sites	Attendance ranged by site (27-84%). Attrition of 15% (29/200). High level of adherence to protocol and collection of follow-up data. Authors discuss the lack of subjective PA data	Intervention developed with maintenance in mind. Community supports were identified for on-going long term sustainability
King et al 2006	25	38-41% participation rate by eligible patients.	Significantly greater increase in MVPA	18-76% adoption rate by eligible health care	Attendance not reported. Attrition of 7.7%	Short duration with no follow-up

		17.8% were non-Caucasian, and 5.1% had an annual income of <US$10,000. Multiple methods of recruitment used	(p=.001) and resistance training (p<0.001) compared to the control group	providers (depending on their status) within the USA health care system	(26/335). Variety of trained staff delivered the intervention, reflecting a real-world setting, with high fidelity to the protocol	
Klug, Toobert & Fogerty 2008	26	73.0% of sample reported an annual income of <US$25,000. 19% were non-Caucasian. Multiple methods of recruitment, with service users consulted beforehand	Significant increase of PA levels at 4-months (p=.0248). 8-month and 12-month follow-up data not reported	Eight individual community sites chose to participate in the programme and assist with recruitment	87.7% (213/243) attended at least 2 sessions. Attrition of 60.1% (146/243) at 4-month follow-up, and 82.3% (200/243) at 12-months, attributed to difficulty with data collection rather than dropout. Conducted an initial pilot study carried out providing insight into recruitment and implementation issues (n=144). Protocols used for both peer delivery	On-going bi-monthly meetings were held with the peer counsellors to ensure on-going fidelity to the programme and provide long-term support

					and site recruitment. Peers maintained fidelity on delivery	
McKay et al 2001	27	Potential for nationwide reach (participants represented 60.8% of the states of USA). Ethnicity and income not reported. Multiple methods of recruitment used, however low uptake due to strict inclusion criteria	Significant increase in MVPA and walking (p<.001)	Not reported	Steep decline in webpage usage over time, which was reported as more prominent in the control group. Attrition of 12.8% (10/78)	Short duration with no follow-up
Osborn 2011	28	64.8% participation rate of eligible participants (118/182). The sample reflected the target population, reaching participants of Latino ethnicity. Income not provided, with 39%	Insignificant trend for increasing PA levels (p=.23)	One site initially targeted	Attendance of 100%. Staff and service users involved in intervention development. Staff were observed to ensure fidelity to protocol. Cost of USD$58 per patient	The authors report that providers could not adopt the programme long term due to minimal grant funding. No further patient follow-up

		reported as unemployed				
Plotnikoff et al 2011	29	Study undertaken as feasibility study with small sample (n=8). Ethnicity and income not reported	No significant change in aerobic PA (p=.48) or resistance PA (p=.12)	Not reported	Attendance of 100%. Feedback from peer counsellors indicated successful delivery of information, but duration too short to observe changes in measureable outcomes	Short duration with no follow-up
Richert et al 2007	30	1500 contacts made with enrolees within 2 year period. Multiple methods of recruitment undertaken within low income area. Local survey reported 11% of the population had heard of the project at 2-years. Details of ethnicity not provided	Population PA levels increased over the initial 2-year period (2005-2007). Population level sedentary activity has decreased to the present day (2011)	High level of adoption by local organisations, with strong sustained partnerships with external organisations to the present day	Attendance and attrition not applicable. Based on intensive social marketing for development and delivery of the intervention. High level of preparation and networking done by project staff prior to recruitment. All peers trained on a regular basis and provided with on-	On-going peer recruitment is key to the sustainability of the programme, therefore, free incentives are offered to peers to maintain the programme. The peer volunteer base has increased from 35 (in 2007) to 100 (2011)

					going support	
Two-Feathers et al 2007	31	300 eligible participants identified, with 151 taking part (50.3%). Multiple methods of recruitment undertaken to reach participants of African-American and Latino ethnicity in a low-income community	Not reported	Several organisations involved in both recruitment and promotion	63% attended 4 of 5 sessions. Attrition of 26.5% prior to intervention start. Peers were observed using a checklist to record fidelity to the programme, and also record questions asked by participants	Moderate duration (5 months), however, no long term follow-up reported
Unsworth & Slee 2002	32	Not reported, however, the programme continues to run (>10 years), indicating success in relation to reach of the programme. Information related to ethnicity and income not provided	Insignificant trend for increasing PA levels	Programme still operating to the present day across urban Western Australia, by several provider organisations	80% attended all 6 sessions. Attrition not reported. Community supports identified for maintenance. High attendance and high level of patient satisfaction with the programme	Programme still operating to the present day across urban Western Australia

Appendix 1. Table 3.4 - Systematic Review Search Strategy

Search Number	**Search terms**
1 Base	((diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise))
2 Base & Context	((diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise) AND national health programs)
3 Base & Context	((diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise) AND national health service)
4 Base & Context	((diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise) AND real world)
5 Base & Context	((diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise) AND diabetes centre)
6 Base & Context	((diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise) AND diabetes clinic)

7 Base & Implementation (mesh only)	((diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise) AND health plan implementation)
8 Base & Implementation (mesh only)	((diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise) AND regional health planning)
9 Base & Implementation (mesh only)	((diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise) AND health promotion)
10 Base & Implementation (mesh only)	((diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise) AND health services needs and demands)
11 Base & Implementation (mesh only)	((diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise) AND health services research)

12 Base & Implementation	((diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise) AND (implement* OR translat* OR into practice OR polic* OR service implem* OR translational medicine OR diffusion of innovation OR information dissemination OR program development OR evidence based medicine OR delivery of health care))
13 Base & Study design (mesh only)	((diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise) AND process assessment health care)
14 Base & Study design	((diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise) AND process evaluation)
15 Base & Study design	((diabetes OR diabetes mellitus type 2 OR type 2 diabetes) AND (physical activity OR motor activity OR exercise) AND (qualitative OR evaluation OR focus groups OR interviews OR surveys OR quasi-experiment* OR policy experiment OR longitudinal study OR cohort study OR impact OR review literature))
16 Additional search terms	Search 1... AND (view OR views OR opinion OR opinions) in the title

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CHAPTER 4

Paper Two

The manuscript presented in Chapter 4 has been prepared for the peer-reviewed journal, *Implementation Science*. The paper is presented using the structure and reference style of the intended publication. Tables and figures are included at the end of the manuscript (page 176).

This paper addresses research question 2 by providing qualitative insight from health professionals regarding the current and future provision of physical activity promotion within routine diabetes care.

Post-viva amendment: A revised version of this manuscript has now been published in the peer-reviewed journal *Practical Diabetes* –

- **Matthews L**, Kirk A, & Mutrie N. (2014). Insight from health professionals on physical activity promotion within routine diabetes care. *Practical Diabetes,* 31(3), 111-116.

Insight from health professionals on physical activity promotion within routine diabetes care: A qualitative study

Lynsay Matthews, Alison Kirk, Nanette Mutrie.

Abstract

Objective

The aim of this study was to explore the views of health professionals on the current and future provision of physical activity promotion within routine diabetes care.

Methods

Responses were collected from participants (n=21) in two individual phases. An online survey (Phase One) and semi-structured interviews (Phase Two) were used to explore the insights and experiences of health professionals on the provision of physical activity promotion. Qualitative responses were analysed using Interpretative Phenomenological Analysis and categorised into themes and sub-themes.

Results

Three main themes were identified: (1) Current physical activity promotion practices; (2) Delivery of physical activity promotion by health professionals; and (3) Future physical activity promotion. Findings demonstrated that a lack of structure for physical activity promotion and a lack of effective behaviour change training opportunities for health professionals made the provision of physical activity advice within routine diabetes care challenging. Health professionals struggled to prioritise physical activity within routine consultations. They were clinically driven to provide physical activity advice to their patients, however, they lacked the skills to elicit significant behaviour change. Five recommendations were presented to improve the future delivery of physical activity advice to individuals with Type 2 diabetes: (1) having a key member of staff responsible for physical activity promotion; (2) access

to a referral route for physical activity support; (3) inclusion of more clinical and diabetes-specific information in behaviour change training; (4) linking the delivery of physical activity promotion with clinical outcomes; and (5) using ‘champions’ to raise the profile of physical activity within the health service.

Conclusions

Incorporation of these recommendations by health professionals and Health Boards may significantly improve the provision of physical activity promotion within routine diabetes care.

BACKGROUND

Health professionals play an integral role in promoting physical activity behaviour change of adults with Type 2 diabetes. Despite physical activity being known as one of the ‘cornerstones’ of diabetes management, research suggests that it remains an under-used component of routine care [1]. Guidelines exist to support health professionals in the promotion of physical activity [2-5]; however, *awareness* of such guidelines may not reflect *adoption* of physical activity promotion within current practice.

Research has reported low rates of physical activity counselling by health professionals within the general population [6-8]. Barriers for physical activity promotion include lack of time, confidence, knowledge, training, and on-going support [9, 10]. Similar, but limited, research has been conducted within the diabetes population. Of the studies available, findings show that health professionals within diabetes care also lack the time, knowledge, confidence, or skills to effectively perform behaviour change consultations within routine care [11, 12].

Health professionals are often under time constraints and struggle to prioritise different aspects of care within diabetes consultations [10, 13]. Appointments are typically of short duration, during which multiple diabetes care issues are discussed, and multiple investigations often performed [11]. Ill-defined roles and responsibilities between health professionals lead to confusion regarding whose responsibility it is to discuss physical activity behaviour change. Importantly, health professionals’ training needs were highlighted by several studies suggesting that while health professionals may achieve short-term behaviour change in their patients, they lack the experience, knowledge and confidence to support their patients in long-term change [11, 12, 14]. Some health professionals may also choose to prioritise their positive relationship with patients by avoiding *judgemental* lifestyle consultations [11].

A key factor to consider is that managers of health services control many aspects of health care which are beyond the remit of health professionals. Funding, protocols and training are determined by health service policy makers based on evidence-based practice, cost-effectiveness and available funding. Support from a management level is therefore required to effectively deliver physical activity promotion as part of routine care.

Although health professionals have a responsibility to provide a high standard of diabetes care, people with Type 2 diabetes are ultimately responsible for their own level of physical activity [15]. Compared with other aspects of diabetes care, however, individuals with diabetes report receiving minimal support for physical activity [16]. The majority of people with Type 2 diabetes are older adults with multiple comorbidities, who experience more barriers to physical activity than the general population, and require greater support to initiate and maintain positive behaviour change [14, 17]. The absence of immediate results, the presence of high risk relapse situations, and misguided information from peers are reported as additional challenges faced by this group [11].

While the focus of physical activity behaviour change research is often to determine which interventions are effective for people with diabetes, there has been little exploration of health care professionals views on which interventions are most appropriate and feasible for delivery by health professionals. Understanding the complex challenges faced by health professionals is therefore necessary to develop future strategies and interventions that may effectively manage the growing burden of diabetes [18].

The aim of this study was to gain insight from health professionals involved in routine diabetes care to address the following research questions:

1. What are the experiences of health professionals in providing physical activity promotion?
2. What insight do health professionals have to inform the future direction of physical activity promotion with routine diabetes care?

METHODS

The methodology for this study included both a nationwide online survey and qualitative interviews with diabetes health care professionals. The survey stage (Phase One) enabled nationwide data to be collected from a wide range of Health Boards. This data informed the design of a qualitative stage (Phase Two) which explored the experiences of key health professionals involved in the provision of care. The survey stage and qualitative stage of the study were designed to complement each other by providing detailed insight into the process of physical activity promotion within routine diabetes care.

- **Phase One: Survey Stage**

A survey stage was implemented to scope the current provision of diabetes care throughout the National Health Service in Scotland. An online survey was designed to gain initial insight from a range of health professionals regarding their experience of providing physical activity promotion to their patients with Type 2 diabetes. The aim of the survey was to provide nationwide quantitative data on the current provision of physical activity promotion throughout Scotland. In addition the survey was also used to inform the design of an in-depth qualitative stage (Phase Two).

Participants

Recruitment of health professionals for the online survey was facilitated via the Diabetes Managed Clinical Network (Diabetes MCN). A Diabetes MCN manager represents each of the 14 Health Boards throughout Scotland and maintains regular contact with staff involved in routine diabetes care. This method of recruitment therefore utilised an established route of communication.

A recruitment protocol was agreed upon between the research team and the Diabetes MCN, which involved each MCN manager identifying two key health professionals within their Health Board; one representing primary care and the other representing secondary care. Health professionals were key members of staff experienced in the management of diabetes within their Health Board, willing to share their views and opinions on the current and future role of physical activity in routine diabetes care. Each Health Board's MCN manager provided the two key health professionals with a participant information sheet. In the event of a non-response, the MCN managers sent a follow-up reminder fortnightly for a total period of 8-weeks.

Participants were invited to complete a short 5-10 minute online survey, providing their views and opinions on the role of physical activity in the current and future management of people with Type 2 Diabetes. Health professionals were encouraged to base their responses on their practical experience. Health professionals willing to participate were directed to a web link, where they were asked to provide informed consent prior to completing the survey online. All responses were anonymous and participants could not be identified from the information provided.

Survey Content

Online surveys have been used in national and international studies and are shown to be an effective method of collecting data from multiple locations [19, 20]. The online survey was designed using the free online source Survey Monkey® and consisted of twelve questions relating to the current and future role of physical activity in routine diabetes care (Table 4.1). Survey questions were developed to address the study's research questions and were based on the researcher's knowledge of diabetes care provision within NHS Scotland.

Health professionals were asked to provide details on the current physical activity provision within their individual Health Board. Questions related to the type of health professionals involved, available resources and the frequency of physical activity promotion (Table 4.1, Questions 1, 2, 5 & 7). Health professionals also provided insight regarding their views and attitudes toward physical activity promotion within routine diabetes care (Table 4.1, Questions 3, 4, 8 & 9). Finally, health professionals were asked to rate various options for the future delivery of physical activity promotion (Table 4.1, Questions 6 & 10). In particular, Question 6 related to changes that could be made to support the current practice of physical activity promotion within their Health Board and Question 10 provided a variety of methods for the future delivery of physical activity promotion. Health professionals were asked to rate these in order of perceived effectiveness. Responses were scored in order of ascending effectiveness i.e. ‘most effective’ received a score of 1 and ‘least effective’ received a score of 6. The survey also provided participants with the opportunity to provide qualitative information that they considered helpful to the future improvement of physical activity promotion within routine diabetes care (Table 4.1, Question 11).

Data collection and analysis

Survey results were collated and stored on a secure online server. Following a data collection period of 10-weeks, all results were downloaded to a Microsoft Excel® spreadsheet. All countable responses were given a numerical score of 1 and presented in the results section as a summative total. Questions 6 & 10, which asked participants to rate options in order of effectiveness, were analysed in a similar manner with the ‘most effective’ response having the lowest summative score and the ‘least effective’ response having the highest summative score. Qualitative data were analysed for trends and themes that could be utilised to inform the development of semi-structured interviews for the qualitative stage of the study (Phase Two).

- **Phase Two: Qualitative stage**

The aim of the qualitative stage was to gain further in-depth insight into the current and future provision of physical activity promotion within routine diabetes care. This was achieved using semi-structured interviews (designed based on the initial findings of the Phase One survey stage) and Interpretative Phenomenological Analysis (IPA), a qualitative method of understanding a group’s perception of a particular topic [21, 22]. IPA combines psychological and interpretative components to analyse the insight of participants. It is an in-depth, inductive process that produces rich thematic and narrative findings and was therefore an appropriate choice to explore the views of health professionals on physical activity promotion within routine diabetes care.

Participants

IPA studies use *purposeful sampling* by recruiting participants who share a common experience and can offer meaningful insight on a specific issue [23]. A small sample size is recommended for use in IPA due to the in-depth nature of analysis [23]. Semi-structured interviews were therefore conducted with seven health professionals to explore their experiences, perceptions and attitudes regarding physical activity promotion within routine diabetes care. A broad sample was purposively selected to represent diabetes care within NHS Scotland, where people with Type 2 diabetes are managed in either primary or secondary care depending on the complexity of their condition. A range of participants were therefore invited to represent the key people involved in the promotion, planning or delivery of physical activity promotion for people with Type 2 diabetes. The invited sample (n=7) consisted of input from a) primary care, b) secondary care and c) health service management (see Table 4.2). This broad range of participants ensured that insight reflected multiple aspects of diabetes care.

The 7 participants (who were not participants in the Phase One survey) were identified and recruited via several routes. Health professionals from a single Health Board (NHS Greater Glasgow and Clyde) were recruited through clinical networks and were informally invited to participate during a visit to their department. Those who expressed an interest in the study were formally invited to participate via email and a convenient time for interview was subsequently arranged. Health service policy makers were identified via public information domains and were invited to participate in the study via email. All interviews were conducted in a convenient venue for participants. If a face-to-face interview was not feasible a telephone interview was offered. Informed consent was obtained prior to all interviews.

Data collection

Semi-structured interviews were deemed an appropriate method of data collection as they provided an opportunity for open dialogue between the researcher and participants. They also allowed the researcher to prompt participants for greater detail [24]. This enabled the researcher to encourage participants to elaborate on responses that addressed the study's research questions. The semi-structured interviews included a set of open-ended questions designed to gain information on the experiences and attitudes of physical activity promotion for adults with Type 2 diabetes. Questions were adapted for use with health professionals, policy makers and people with diabetes, but were generally based around the four key topics outlined in Table 4.3. Interview questions were discussed and approved within the research team prior to data collection. Interviews were designed to last approximately 30 minutes.

Interviews were conducted in a private room (e.g. at diabetes clinic), or via telephone for those participants who were unable to meet face-to-face. To ensure continuity, all interviews were conducted by LM between May and November 2012. Participants were assured that their responses would remain anonymous.

Analysis

All interviews were recorded with consent using a digital Dictaphone and interview transcripts were transcribed verbatim. Identifiable information was removed from transcripts to maintain participants' anonymity. The interview data were explored using IPA; a method of forming conclusions about a specific group's perceptions of a particular topic [21, 22]. Interview transcripts were examined in detail, coded and analysed for emerging patterns of codes (known as themes) [21]. The aim of IPA is for the researcher to interpret the meaning of participants' experiences therefore codes and themes were generated *from* the data, rather than from a pre-existing framework [23]. Subsequent themes and sub-themes were cross-checked by two researchers, who each independently coded two interview transcripts. Two additional researchers (AK, NM) reviewed the final themes and sub-themes as a further measure of inter-rater reliability. This approach strengthened the *trustworthiness* of the analysis by establishing *credibility* and reducing researcher bias [25, 26]. Minor differences in identified themes were resolved by discussion. Continuity of interpretation was ensured by one researcher (LM) being responsible for the data collection and analysis. Interview transcripts were analysed and coded using NVivo® qualitative software.

Ethics

Ethical approval was granted by the University of Strathclyde's Ethics Committee and all aspects of the study adhered to the University of Strathclyde's Code of Conduct for research.

RESULTS

Phase One: Online Survey

The online survey received a response rate of 57.1% (n=16 of 28 potential responders), which represented 78.6% of the available health boards in Scotland (n=11 of 14 potential health boards). Primary care and secondary care were represented equally with 8 responders from each sector. The survey received responses from a range of health professionals including management (n=2), consultant physicians (n=3), diabetes nurse/practice nurse (n=6), GP (n=4) and one anonymous responder.

Five specific health professionals were identified as being part of routine diabetes care (Table 4.1, Questions 1-4). Primary care included GPs and practice nurses. Secondary care included consultant physicians, diabetes specialist nurses and dietitians, with some being involved in both primary and secondary care. Participants were also asked to report whom, in their opinion, should have the main responsibility for physical activity promotion. Overall, practice nurses (primary care) and diabetes specialist nurses (secondary care) (n=10) were considered to be the most important providers of physical activity advice, closely followed by consultant physicians (n=9), GPs (n=9) and dieticians (n=8). A small number of participants (n=3) considered that physical activity experts, Health Care Assistants and health psychologists held the main responsibility.

Health professionals were provided with six potential factors that could improve physical activity promotion within their Health Board and were asked to rate these in order of effectiveness (Table 4.1, Question 6). Access to an exercise referral scheme (Score=32) and an established route of referral (Score=37) were rated as the most effective strategies for improving local physical activity promotion. Identifying a key member of staff for physical activity advice (Score=42) and staff training (Score=46) were rated as being the next effective strategy, with access to additional resources collectively rated as the least effective strategy (Score=60). Health professionals made two additional suggestions that could improve physical activity promotion within their Health Board. These included (1) closer links with staff involved in current council [local authority] programmes and (2) small local workshops for patients within a health centre or general practice.

Health professionals were also presented with five potential strategies for future implementation of physical activity services and asked to rate these in order of effectiveness (Table 4.1, Question 10). A single 30-minute Physical Activity Consultation delivered by a physical activity consultant, tailored to the personal circumstances of the individual, was collectively rated as the most effective strategy (Score=27). Physical activity advice given by a practice nurse or diabetes specialist nurse at routine visits was rated as the second most effective strategy (Score=35), followed by group education (Score=41) and physical activity promotion by dieticians (Score=53). Physical activity advice by GPs and consultant physicians at routine visits was collectively perceived as the least effective method of physical activity promotion (Score=56).

Additional data were obtained from Questions 7-9 (Table 4.1). These findings neither informed the design of the qualitative stage, or added sufficient detail to address the research questions of this study and are therefore not reported here.

Phase Two: Semi-structured Interviews

Following analysis of the interview transcripts (n=7) three main themes were identified. Each main theme was divided into relevant sub-themes which are outlined in Table 4.4. The findings are presented below with accompanying extracts from participant interviews.

Theme 1. Current physical activity promotion practices

This theme explored the current practices of health professionals in relation to physical activity promotion for their patients with Type 2 diabetes.

a) Promotion of general physical activity advice

Health professionals were aware of the benefits of physical activity for their patients with Type 2 diabetes.

> *We would give specific information on exercise if the patients were on insulin, talking about hypos etc… but otherwise it would just be general ; why exercise is good for you; exercise is good for your heart; your blood pressure; good for your blood sugars; maintain better control; good for weight loss and things like that (Diabetes Specialist Nurse).*

They provided general physical activity advice that they perceived would encourage patients to increase their level of physical activity. Appropriate activities, such as walking, were highlighted as suitable options for patients.

> *We try to stress to them, especially if they're poorly controlled, the importance of a wee bit more exercise than they are doing; you know walking the dog; walking*

> *around the room; just even gentle exercise. Walking is a good exercise I always say. You don't have to join a gym; you don't have to go running (Diabetes Specialist Nurse).*

The importance of using appropriate terminology when discussing physical activity with patients was also highlighted.

> *So I tend to encourage physical activity and I'm very conscious not to use the word 'exercise'. Although I'm a very keen person for exercise particularly when I'm seeing new patients (Endocrinologist).*

b) Reasons why health professionals did not promote physical activity to patients

Health professionals described the importance of individually assessing each patient's ability to perform physical activity. Perceived barriers, such as impaired mobility and older age, were highlighted as reasons why health professionals did not provide physical activity advice.

> *I mean a lot of them can be in wheelchairs or on walking sticks and physical activity would not be possible or a priority with them. So that would probably be the main reason [why physical activity is not discussed] (Dietitian).*

In some cases, health professionals assumed that other colleagues had discussed physical activity with the patient.

> *Although I think I do it a lot [promote physical activity], it's probably not as much as I'd like to. I guess part of it's you assume that someone, sometime in the past, has discussed it with them (Endocrinologist).*

c) Confusion regarding access to resources

An issue regarding awareness of departmental resources was identified. Some health professionals believed their colleagues had access to physical activity resources.

> *We have some general leaflets about benefits of increased physical activity in diabetes. I would pass the patient onto the nurse to get that sort of information but nothing more specific than that that I'm aware of (Endocrinologist).*

However, their colleagues were unaware of any physical activity resources they could provide for patients.

> *I don't think we do [have resources]. I think it's all just by mouth. We're just telling them about it. They can get referred to exercise classes from their GP though but we don't tend to do that … as I say we have no great resources to give to patients or anything (Diabetes Specialist Nurse).*

d) Clinical focus on diabetes care

Health professionals were aware of the clinical focus on diabetes management and diabetes outcomes, especially in relation to achieving optimal blood glucose control.

> *Clearly I'm aware of the broader health benefits [of physical activity] as well and the population benefits, but I think on a one-to-one it's trying to get a target benefit with that particular patient. So it's very clinically driven I'd say (Endocrinologist).*

However, the need to be proactive and add physical activity promotion to routine diabetes care was identified.

> *We probably should be more proactive [with physical activity promotion], and we're not, probably not. We tend to concentrate on blood glucose levels and diet. And physical activity comes along probably next. So I think we should be more proactive (Diabetes Specialist Nurse).*

e) Image presented by health professionals

Health professionals were aware that their appearance and attitude could influence patients. Some perceived their weight presented a negative image to their patients.

> *I think personally they probably look at me being overweight and think 'well what is she doing'? A lot of them do. But then I say, 'well I'm not diabetic' (Diabetes Specialist Nurse).*

Other health professionals actively attempted to present a positive image to their patients by engaging in a physically active commute to work.

> *Several of us do actually 'walk the walk' and 'talk the talk'. So I think that does actually help as well … Several of us cycle and I think that does help. It kind of normalises increasing physical activity rather than it being something that only a funny group of people do and it's done in a gym sort of thing (Endocrinologist).*

Theme 2. Delivery of physical activity promotion by health professionals

This theme described the perceptions of health professionals on the delivery of physical activity promotion within routine diabetes care.

a) Staff responsibility for physical activity promotion

Individuals with Type 2 diabetes encounter numerous health professionals during the course of their diabetes care. Those patients managed in primary care predominantly visit their practice nurse or GP, while people managed in secondary care typically visit their consultant endocrinologist, diabetes specialist nurse and dietitian. Health professionals believed that everyone involved had a shared responsibility to promote physical activity to people with Type 2 diabetes.

> *Physical activity and discussing it plays a big role in my job. Other members of my team also discuss it in their clinics and I think it is important that everyone does their bit. It should not be left to one person (Practice Nurse).*

However, the benefit of an official route of referral or having a key member of staff responsible for regular delivery of physical activity information was highlighted.

> *I am happy to advise but do not have the time to do the actual promotion myself. A dedicated service to which we can refer seems best (GP).*

> *I actually believe that physical activity is as important as diet but we don't have a physical activity specialist attached to clinics, whereas we do have dietitians. In a local team it would help if one person took a lead on it and had a bit more training on it (Endocrinologist).*

Dietitians and diabetes specialist nurses were identified as potential key members of staff.

> *Because we have the sort of overall [care of the patient] … we're looking at the blood sugars; we can talk to them about how it's [physical activity] affecting their blood sugars and everything. So yeah I think we could be the appropriate people, given the training (Diabetes Specialist Nurse).*

However, the need for a key member of staff or specialist was not regarded as achievable by some health professionals due to current staffing levels.

> *There is limited staffing to designate one person to the job. It's probably best done as it is at the moment with everyone promoting it in their own clinics (Practice Nurse).*

> *I think there's no harm in having a key member of staff who has got a particular knowledge or expertise or advisory function, but I wouldn't want to create a dependency on one individual (Health Service Policy Manager).*

b) Identified need for behaviour change training

Despite health professionals having sufficient knowledge to provide general physical activity information they recognised their limited skills in delivering effective behaviour change consultations.

> *I feel I am only able to give basic advice but use the pilot scheme [physical activity referral] as an option for patients to attend for more information (Practice Nurse).*

I think we lack experience in training in teaching patients about physical exercise. Because we've no resources really (Diabetes Specialist Nurse).

Health service management provided behaviour change training for staff which aimed to build the capacity of health professionals to effectively deliver behaviour change advice. Training also focussed on raising awareness for health professionals on what other support routes were available to them. Knowledge of local access to resources and facilities was discussed.

If you ask the question you need to know what to do with the response and nurses and other practitioners may feel they haven't got the information to provide. That's why the capacity building is probably essential because it doesn't need to be difficult. It's just really highlighting the issue and then signposting the person to some supports near their home (Health Service Policy Manager).

Raising awareness of the local exercise referral scheme was a key training priority of the local Health Board.

The way it works is we try to get them [GPs and practice nurses] to refer them through to the exercise referral scheme as the number one choice. Because they are a behaviour change service around physical activity. They have the time and the capacity to sit down and actually have that detailed conversation with people that they won't get within practice. So what we're essentially saying to GPs and practice nurses is 'identify people who need to increase their physical activity and want to increase their physical activity and then refer on'. We're kind of saying that's your job done (Health Board Policy Manager).

c) Issues related to delivery of behaviour change training

Behaviour change training was routinely provided for health professionals. However, issues were identified with the training provision. Health professionals were noted as going on repetitive training days.

The way they used to work was that each disease had its own training day. So you'd go along for diabetes and you'd go along for heart disease etc… But what would happen would be it would be the same people that would go to them all… So the same people were sitting there thinking 'we've seen the same slides two *weeks ago this presentation', apart from the two slides that are disease specific (Health Board Policy Manager).*

There was disparity between the types of health professionals attending behaviour change training.

We rarely get GPs attending the [behaviour change] training days. It's mainly nurses (Health Board Policy Manager).

The provision of 'general' information was highlighted as a barrier to engaging health professionals in the importance of physical activity. It was suggested that due to health professionals having a clinical focus on diabetes care the training should reflect this by providing specific clinical examples.

We're not being clinical enough for the audience. For that particular audience I think what we need to do is make it a lot more specific to their patient, so for diabetes here is how specifically physical activity is going to benefit your patient. I think that's the level that we need to go to (Health Board Policy Manager).

There was difficulty engaging health professionals in training sessions. Some attended with a negative attitude, perhaps due to the training being compulsory.

We've got loads of people coming along. We've also done specific training for practice nurses. So we've all had the training. The difficulty is before you start there's attitude issues, because they'll sit there and they'll tell you "we know all this!" They are disengaged before you've even started the session (Health Board Policy Manager).

d) Barriers to physical activity promotion

Numerous factors were identified as potential barriers to the provision of physical activity advice by health professionals. Firstly, limited information on available resources for health professionals and patients.

I'm not aware of where we can refer patients to. I sometimes say to the patients, you know, you're GP could probably [give them information] … they probably get access to more resources than we have (Diabetes Specialist Nurse).

Secondly, health professionals discussed time constraints of patient visits. Limited time capacity did not allow health professionals to bring about significant changes in physical activity behaviour.

> *Time pressures. Remembering to do it with all the other checks which are required (GP).*

> *I think though that in this clinic, which deals with complex cases, we don't' always have the time to bring about changes [in physical activity] (Dietitian).*

Within that limited time remit health professionals described the need to focus on a primary management goal.

> *We are time pressured in our interaction with patients so we can't really cover all aspects of diabetes care with them in one visit, never mind the aspects of wider care. So it's almost a focus thing, focussing it all on blood pressure, or focussing it on foot care or something like that (Endocrinologist).*

Thirdly, the format of some health consultations was perceived as a barrier in itself. At annual health checks health professionals were required to follow a computer template addressing behaviour change. However, the large volume of data collected for the consultation was identified as a barrier.

> *The fact that we ask and collect so much data actually impacts on the consultation. It should be a conversation between the practice nurse or the GP and that individual, whereas we've got the practice nurse actually looking at the screen for the whole time that they're in it because they have to click so much data (Health Board Policy Manager).*

e) Facilitators for physical activity promotion

Factors which encouraged the provision of physical activity promotion by health professionals were identified. Firstly, the need to achieve positive clinical outcomes was highlighted.

> *It's usually to address specific needs, clinical needs of the patient. So it might be somebody whose HbA1C is slight higher than we'd like. So then the benefits of increasing their physical activity might get them to their desired target (Endocrinologist).*

Secondly, targeting physical activity promotion for the spring and summer months may consequently result in a greater number of patients considering changing their behaviour.

> *But if they've been thinking about it, especially at this time of year when it should be getting warmer and drier, and people tend to be more active in the summer anyway, if they've been thinking about it then you can be giving them the health benefit information, then it'll help. But I don't think me saying it actually does it; it helps if the patient has been thinking about it (Endocrinologist).*

Thirdly, knowledge of local physical activity opportunities may encourage health professionals to provide physical activity information to their patients.

> *I think proximity would help. If a member of staff is giving brief advice to somebody and there were other options for good walking routes in the area, cycling routes, if there was sport or leisure centre nearby, it allows the advice to be I suppose more real. Rather than saying there's a place 5 miles away or what have you, because a person can immediately go to the setting as soon as they leave the consultation (Health Service Policy Manager).*

Finally, having a champion for physical activity promotion within the health care staff may encourage colleagues to increase their rates of physical activity promotion. In particular it was noted that having a champion with professional credibility raised the profile of physical activity within a department.

> *If you can get the clinical directors and local champions, that have a credibility, like a peer. So instead of me from Health Improvement saying 'you should be referring', but if it's Dr Such and Such the clinical director in that area, who they kind of respect, you know at that level there's a kind of credibility that says 'yeah we need to do something about this, we need to raise the profile of physical activity, it's really important'. I think that credibility of someone they recognise kind of comes with it as well (Health Board Policy Manager).*

Theme 3. Future physical activity promotion

Several issues were raised which were related to the future promotion of physical activity in practice. These related to factors perceived integral to the success of future services.

a) Avoiding information overload for patients

The importance of balancing the quantity of information given to patients at each visit was highlighted by various health professionals. They discussed the potential for having a dedicated member of staff provide physical activity information at routine health visits.

> *If they've [the patient] had quite an upsetting consultation with one of them [the health professional]; or if they've you know had to change onto insulin; or had major changes to their blood sugar control; and then having to see another person at that clinic [for physical activity advice], that would be too much. But I suppose if everything has been running quite smoothly [this would be an option] (Dietitian).*

Although the idea of having a dedicated member of staff for physical activity had potential benefit, there was a need to limit the number of health professionals a patient saw per visit.

> *So they did come in and get a dietary assessment, they saw me, they then saw a nurse specialist for blood monitoring advice. So they'd be processed through by the clinic nurse as well, so I think you can overload patients in a single visit, but I think you can certainly see two [health professionals] (Endocrinologist).*

Behaviour change training provided by the Health Board aimed to limit the potential problem of information-overload by training health professionals to identify a priority behaviour for management in each visit.

> *So potentially that individual is walking out with five referrals. "I'm stopping smoking, I'm losing weight, I'm stopping drinking, I'm increasing my activity". So*

it's how we manage that and that's where we deliver training around behaviour change and prioritising a single behaviour (Health Board Policy Manager).

b) Policies and strategies for physical activity promotion

The future provision of physical activity promotion for individuals with T2D is largely controlled by current policies and strategies. There was confusion and frustration regarding the numerous and overlapping physical activity strategies that had been published.

We've got a national physical activity strategy and following that we've now got a kind of national cycling action plan and we're now developing a walking strategy. Why do we need a walking strategy? We've got a perfectly good physical activity strategy that references walking (Health Board Policy Manager).

The introduction of government targets for the National Health Service was also identified as a factor influencing the provision of physical activity promotion within practice. Local Health Boards were identified as being under pressure to achieve specific health–related targets (e.g. smoking cessation) in order to secure future funding. Physical activity was not listed as a target, therefore, it was suggested that physical activity would not be a priority for health professionals.

We've now got HEAT targets and physical activity isn't a HEAT target. So if you've got a target that's going to be measured by the government then all the focus will go on that. So that's what the local health improvement teams will do they'll do; they'll focus on the HEAT targets, the big things they are going to be judged against (Health Board Policy Manager).

To overcome the challenge of physical activity not being listed as a National Health Service target, local policy makers ensured physical activity was included in Health Board planning frameworks. However, a lack of consistency across different Health Boards was identified.

We do try and get it [physical activity] in planning frameworks so that there is a responsibility for the areas [Health Boards] to do something about physical activity. But it's patchy [across the Health Boards] (Health Board Policy Manager).

Funding played a key role in the capacity of Health Boards to provide adequate physical activity promotion. Services were limited by a small budget allocation for physical activity.

> *Our physical activity budget, we get within the Health Board, is about 3/4million [GBP], so we put about GBP750,000 into the physical activity, the core budget ... So that's less than a pound per person spending on physical activity within the [Health] Board. The majority of that funding will go to our exercise referral scheme for the salaries of our [physical activity] advisors (Health Board Policy Manager).*

c) Evaluation of physical activity promotion strategies

The importance of effectively evaluating current physical activity strategies to inform the development of future strategies was discussed.

> *The need for further evidence and research and evaluation and dissemination of that [physical activity strategy] to ensure that the practice is maintained at all times. Then the whole communications media element and making sure we're getting the right messages going out and no conflicting messages for members of the public (Health Service Policy Manager).*

In addition to large scale evaluation it was also highlighted that individual health professionals should consider evaluating their current knowledge of available physical activity services.

> *So I think there are a few things [issues] for people referring. One, it's the ease with which it is to refer? Two, is it going to benefit my patient? Three, do they have a confidence in the service they referring on to? Four, what do they know about the service? (Health Board Policy Manager).*

DISCUSSION

This study adds to the current literature on diabetes care by exploring the insight of health professionals regarding the provision of physical activity promotion within everyday practice. The aim of the study was to address the following research questions:

1. What are the experiences of health professionals in providing physical activity promotion?
2. What insight do health professionals have to inform the future direction of physical activity promotion with routine diabetes care?

What are the experiences of health professionals in providing physical activity promotion?

Responses from the online survey (Phase One) and semi-structured interviews (Phase Two) identified three key findings regarding the provision of physical activity information. Firstly, there was a lack of structure for physical activity promotion within routine diabetes care. Confusion from health professionals regarding access to resources, a lack of referral route for physical activity support, and ill-defined roles for health professionals created a significant challenge in the promotion of physical activity. It was agreed that in an ideal health care setting all health professionals should have the responsibility, knowledge and skills to effectively deliver physical activity information. However, in practice, health professionals were pressured by time constraints and the need to prioritise clinical matters. They identified the potential benefit of having an identified member of staff responsible for physical activity promotion. Similar to a dietician being the key contact for dietary advice, a trained member of staff could be the key contact for physical activity advice. It was suggested this approach would improve structure and continuity of care in relation to physical activity. There was a mixed response regarding who the key staff member should be. Research suggests that patients consider their GP to be the most trusted source of physical activity advice [27]. However, results from our online survey found that GPs and consultant endocrinologists were perceived by health professionals as the least effective route for patients to receive physical activity information. This was reflected in the interviews where it was noted that physicians rarely attend behaviour change training courses. Previous research has also found physicians to have less training in behaviour change or person-centred practice than other health professionals [28].

In contrast, both the online survey and qualitative interviews identified dietitians, practice nurses and diabetes specialist nurses as effective sources of physical activity promotion. Dietitians have the opportunity to address combined lifestyle advice. Dietary changes in combination with increased levels of physical activity are known to be more effective in promoting weight loss and health outcomes than dietary changes alone [29, 30]. Patients with Type 2 diabetes have previously reported finding it easier to manage dietary changes when in combination with physical activity [31]. However, additional training may be required for dietitans to be able to provide effective physical activity information as a study by McKenna et al [32] found that fewer than 1 in 4 dietitians had received formal training on physical activity promotion. Johnson et al [33] found that, following a physical activity training workshop, referral rates of dietitians to physical activity experts increased.

With regard to other health professionals, nurses have been identified as having a closer relationship and more person-centred approach with their patients than physicians [28]. Our findings supported this previous research. Practice nurses and diabetes specialist nurses were considered a trusted and reliable source of physical activity information by both health professionals and patients. The online survey also found practice nurses and diabetes specialist nurses to be the main attendees of behaviour change training courses. Despite their important role minimal research has explored the feasibility of delivering physical activity promotion for people with diabetes via practice nurses and diabetes specialist nurses.

The second key finding was that the format of behaviour change training was ineffective. Several training issues reduced the overall effectiveness of the workshops. Firstly, health professionals were required to attend disease-specific training courses (e.g. diabetes, stroke, coronary heart disease) where they were presented with *repetitive* physical activity information. Secondly, training workshops failed to engage health professionals on the benefits of physical activity for their patients with diabetes. It was suggested that the delivery of more clinical information in addition to specific diabetes examples would help engage, inspire and motivate health professionals in the promotion of physical activity for their patients. Thirdly, behaviour change training was often attended by health professionals with a reluctant and negative attitude. This may have been due to the workshops being compulsory or not engaging enough. These findings do not compare with all data from our study. Results from the online survey found that the provision of behaviour change training was perceived by health professionals as one of the most effective methods of improving physical activity provision in practice. This was also echoed by some of the qualitative interviews where health professionals acknowledged their lack of skill in eliciting significant behaviour change in their patients. Previous studies in the diabetes and non-diabetes population have also found that health professionals, although motivated to promote physical activity to their patients, lack the skills necessary to initiate or maintain behaviour change [9, 11]. These findings suggest that although health professionals do require behaviour change training for physical activity the current provision of training could be improved to meet their needs. The delivery of engaging, interesting and motivating training workshops may enhance positive attitudes towards behaviour change training and the future provision of physical activity promotion for individuals with Type 2 diabetes. Anticipated findings from the current *Movement as Medicine* study may provide further insight into the provision of training for health professionals within everyday practice [34].

The third key finding identified that a clinical focus on diabetes care acted as both a barrier and facilitator to physical activity promotion. A focus on achieving clinical outcomes via medication and diet reduced the priority and time available for physical activity promotion. In contrast, health professionals were more likely to discuss physical activity if they thought it would have a benefit on clinical outcomes for their patient. This compares with research undertaken in the general population where health professionals in primary care were more likely to discuss physical activity with their patients if it related directly to clinical outcomes [8]. Findings showed that health professionals were more likely to promote physical activity to overweight and obese patients without diabetes (98%) than their patients with diabetes (85%). The current evidence base has shown that physical activity plays a critical role in the development of positive clinical outcomes in individuals with diabetes. These include improved blood glucose control, increased insulin sensitivity, improved fat oxidation and overall decreased risk of long-term complications [2, 35]. Supporting individuals with Type 2 diabetes to increase their physical activity levels could therefore significantly improve clinical outcomes. Supporting health professionals to associate clinical outcomes as a *facilitator* for physical activity promotion may increase the frequency and quality of future physical activity information. Behaviour change training should also highlight the importance of also improving psychological and social outcomes; important factors in the quality of life of individuals with chronic disease. This finding supports the proposed format change of behaviour change training to engage health professionals by including the delivery of more clinical and diabetes specific physical activity information.

What insight do health professionals have to inform the future direction of physical activity promotion with routine diabetes care?

Responses from the online survey and semi-structured interviews highlighted two issues regarding future physical activity provision. Firstly, access to a behaviour change specialist was recommended. The delivery of effective physical activity interventions is a complex process which requires an understanding of the psychology of behaviour change [36]. It is unfair to expect health professionals to effectively change the behaviour of their patients in a single session of short duration when other management issues may take priority. Behaviour change interventions, provided by trained professionals for patients identified as ready to change their behaviour, are known to be effective in increasing physical activity levels and health outcomes in individuals with diabetes [37]. This links with the *'identify and refer'* method of physical activity promotion recommended by health service management. In order for this method to work health professionals require effective training to identify appropriate patients and direct them to appropriate services. The need for this training is supported by a recent review of services within NHS Greater Glasgow and Clyde (where the majority of insight for this study was collected). Seventy-two percent of adults with Type 2 diabetes reported to a health professional that they were ready to change their physical activity behaviour, however, only 11% received physical activity advice and only 1% were referred to the existing exercise referral scheme [38].

In our online survey access to a physical activity consultant and/or Exercise Referral Scheme was rated by health professionals as the single most effective factor in improving the current provision of physical activity information. The effectiveness of Exercise Referral Schemes within the general population is uncertain [39], however, we know of no research which has explored the effectiveness of Exercise Referral Schemes for individuals with diabetes. Some evidence exists to suggest that Exercise Referral Schemes can be effective for people with coronary heart disease [40] and can elicit short term increases in physical activity for sedentary individuals [39]. In contrast, there is strong evidence to support the role of a ‘physical activity consultant’ in the delivery of individually tailored physical activity information [3, 41, 42].

Secondly, health professionals identified the need to avoid information overload for individuals with diabetes. In particular, previous research has highlighted the importance of avoiding information overload in those patients who do not yet appear interested in behaviour change [43]. Effective behaviour change training should support health professionals to identify the ideal timing and balance of information to provide their patients with diabetes. Evaluation of current practice is essential to identify areas for improvement. Finally, there was a need for the government to consider physical activity as a priority health service target. Interview responses from health service managers suggested that the focus of the health service went towards achieving government set targets (e.g. greater referrals for smoking cessation). Despite physical activity being recognised as important in the prevention and management of many chronic diseases it was not officially considered a health target. It was suggested that ‘champions’ for physical activity could help raise the profile of physical activity within the health service. Recent guidelines on the delivery of brief physical activity advice in primary care also recommended raising the profile of physical activity by linking it to current health frameworks (e.g. the NHS Quality and Outcomes Framework) [44]. This further supports the previous key finding of using clinical outcomes to facilitate physical activity promotion. Further recommendation and guidelines such as these may improve the delivery and funding available for physical activity within routine diabetes care.

Strengths and Limitations

This study presented valuable information regarding the current and future provision of physical activity promotion within routine diabetes care. The promotion of effective behaviour change for physical activity is a complex process and therefore challenging to explore. However, this study utilised several methodological strengths by undertaking an online survey across a wide range of Health Boards, followed by an in-depth qualitative phase in one individual Health Board. An IPA approach to analysis ensured in-depth interpretation of the findings. Several limitations need to be acknowledged. First, the generalizability of the findings. The provision of routine diabetes care varies between countries therefore the findings from this Scotland based study may not reflect those of other countries or other parts of the UK. However, readers may find that the key-stakeholders involved in their own diabetes care continue to be GPs, nurses, consultant endocrinologists and dietitians. Therefore many of the findings may still be applicable to other health care systems. Second, there may be a response bias from participants in the study. Participants who accepted the invitation for a semi-structured interview were motivated to share their views and opinions on physical activity promotion. They may have stronger opinions on this topic that their colleagues who declined to participate.

CONCLUSIONS

A lack of structure for physical activity promotion and a lack of effective behaviour change training opportunities for health professionals made the provision of physical activity advice within routine diabetes care challenging. Several recommendations were presented for improving the future delivery of physical activity advice to individuals with Type 2 diabetes. These included: (1) having a key member of staff responsible for physical activity promotion; (2) access to a referral route for physical activity support e.g. Exercise Referral Scheme or physical activity expert; (3) improved format of behaviour change training to engage health professionals with more clinical and diabetes-specific information; (4) linking the delivery of physical activity promotion with clinical outcomes; and (5) using ‘champions’ to raise the profile of physical activity within the health service and linking it with current policy frameworks. Incorporating these recommendations may significantly improve the long-term outcomes of individuals with Type 2 diabetes via increased levels of physical activity.

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Table 4.1. Online survey questions

Question	*Choose from the following options*
1. Which health professionals are currently involved in routine diabetes care? 2. Which health professionals currently provide physical activity information to people with diabetes? 3. In your professional opinion, which health professionals *should* be involved in physical activity promotion? 4. In your opinion, which health professional do you consider should have the *main* responsibility for providing physical activity information?	Choose all that apply. – Consultant Physician – GP – Diabetes Nurse – Practice Nurse – Dietician – Health Psychologist – Physiotherapist – Occupational Therapist – Ophthalmologist – Physical Activity Expert – Other (please specify)
5. What resources are currently used to facilitate current physical activity promotion in your department?	Choose all that apply. – Posters – Leaflets – Booklets – HP discussion – Referral advice – ERS – Other (please specify)
6. What would help to improve the effectiveness of physical activity promotion for Type 2 diabetes in your department?	Rate in order of effectiveness. Score 1 (most effective) – Score 6 (least effective). – Access to an exercise referral scheme – Behaviour change training for staff – Additional resources (e.g. leaflets, booklets) – Key member of routine staff responsible for physical activity advice (e.g. practice nurse) – Referral route for physical activity advice (e.g. physical activity consultant, health psychologist) – Other (please specify)
7. What proportion of people with diabetes currently receive physical activity promotion in a typical week?	Choose one answer. – 0-20% – 21-40%

	– 41-60% – 61-80% – 81-100%
8. In your professional opinion, how often should people with diabetes receive physical activity promotion?	Choose one answer. – Always – Frequently (at most visits) – Sometimes (at occasional visits) – Rarely – Never
9. In relation to Type 2 diabetes how do you feel about your - a) Knowledge of the benefits of physical activity b) Knowledge of the risks of physical activity c) Ability of '*what* to say' d) Ability of '*how* to say it' e) Ability of '*when* to say it' f) Ability to respond to queries	Choose one answer per question. – Very confident – Moderately confident – Slight confident – Not confident
10. Please rate the following strategies for physical activity promotion in order of effectiveness	Rate options in order of effectiveness Score 1 (most effective) – Score 6 (least effective). – GP/consultant physician discussing physical activity at any visit – Diabetes/practice nurse discussing physical activity at any visit – Dietician discussing physical activity at same time as nutritional advice – 1 x 30min session by a physical activity consultant tailored to the individual patient – Group education session with other patients – Other (please specify)
11. Please provide any other information that may help us collate data related to PA promotion for T2D across Scotland. All additional insights are welcomed.	– [text response]
12a. What health board are you based in? 12b. Do you work in primary or secondary care? 12c. What is your job title?	– [text response]

Table 4.2. Key people invited to participate in semi-structured interviews (n=7)

Primary Care	*Secondary Care*	*Health Service Managers*
General practitioner	Consultant diabetologist	Regional health service policy maker
Practice Nurse	Diabetes Specialist Nurse	National health service policy maker
	Dietitan	

Table 4.3. Topic list for semi-structured interview questions

Semi-structured interview: Topic List	
1.	Knowledge of the relationship between physical activity and Type 2 diabetes
2.	Personal/professional view on the role of physical activity in the management of Type 2 diabetes
3.	Experiences of providing or receiving physical activity information for Type 2 diabetes
4.	Insight on how a future physical activity service for Type 2 diabetes should be developed, delivered and managed

Table 4.4. Key themes and sub-themes following analysis of interview transcripts

Theme 1. Current physical activity promotion practices

b. Promotion of general physical activity advice
c. Reasons why health professionals do not promote physical activity to patients with T2D
d. Confusion regarding access to resources
e. Clinical focus on diabetes outcomes
f. Image presented to patients by health professionals

Theme 2. Delivery of physical activity promotion by health professionals

a. Staff responsible for physical activity promotion
b. Identified need for behaviour change training
c. Issues related to the delivery of behaviour change training
d. Barriers for physical activity promotion
e. Facilitators for physical activity promotion

Theme 3. Future physical activity promotion

a. Avoiding information overload for people with T2D
b. Policies and strategies for physical activity promotion
c. Evaluation of physical activity promotion strategies

CHAPTER 5

Paper Three

The manuscript presented in Chapter 5 has been prepared for this thesis as one paper. Following submission of the thesis we plan to prepare and submit the final manuscripts to peer-reviewed journals as two individual publications. Submission is planned for December 2013 following final follow-up data from our collaborators in NHS Grampian. The paper is presented using the structure and reference style of the intended publication, *Diabetes Care*. Tables and figures are included at the end of the manuscript (page 214).

This paper addresses research question 1 by providing an evaluation of the development and set-up stage of a physical activity consultation service for adults with Type 2 diabetes in a pilot area of Aberdeen, NHS Grampian.

N.B. Student's role in the development of the physical activity consultation service

It is important to clarify my role in the development of the physical activity intervention. As mentioned in the Overview chapter at the start of the thesis our PhD team was approached by colleagues in NHS Grampian to discuss options for evaluating their proposed physical activity consultation service. The NHS Grampian staff already had an intervention protocol and ethics application prepared prior to our first meeting. They were keen to implement and evaluate a physical activity consultation service based on the diabetes-specific guidelines published by my first supervisor, Dr Alison Kirk.

My role as PhD student, during the development stage, was to help refine the intervention protocol so that process evaluation data could be collected as the intervention was being implemented. This involved identifying appropriate methods and time points for data collection and analysis.

To avoid confusion for readers of this thesis the physical activity consultation intervention was not chosen or designed by me based on background research or the findings of my PhD (Chapters 2-4). It was, however, an opportunity to identify and present the type of process data that is often missing from other publications. This research gap was identified in both Chapter 2 and Chapter 3. The subsequent findings presented in this chapter therefore provide an example of the informative findings which can be obtained from effectively evaluating interventions in an everyday setting. The purpose of the following chapter is not to necessarily promote physical activity consultation as the single most effective method for promoting physical activity in adults with Type 2 diabetes but rather to present process data for publication.

The feasibility, effectiveness and implementation of a physical activity consultation service for adults within routine diabetes care.

Lynsay Matthews, Alison Kirk, Nanette Mutrie, Mary McCallum, Ann Gold, Andrew Keen.

ABSTRACT

Aim: To explore the feasibility, implementation and effectiveness of a physical activity consultation service for adults within routine diabetes care.

Methods: A 12-month physical activity intervention was delivered for adults with type 1 or type 2 diabetes within one area of the National Health Service, UK. Promotion of the service was provided within primary and secondary care, the media, and local diabetes exercise classes. Participants received an initial 30-minute face-to-face consultation, monthly follow-up consultations for 6-months (face-to-face, e-mail, or telephone), and further face-to-face consultations at 6 and 12-months. Consultations were delivered by an Exercise Health Psychologist, guided by behaviour change strategies, and tailored to stage of change.

Results: Fifty-one patients enrolled during the initial 20-months of recruitment. Participants were 51.2% female, mean age 60.9±10.2 years, mean BMI 33.1±6.9, 83.7% with type 2 diabetes, and 55.8% with multiple co-morbidities. A significant increase was observed from baseline at both 6 & 12-months in the number of participants achieving the physical activity recommendations (21.3% vs 66.7% vs 60.5%; $P<0.02$). A significant increase was observed in mean change for positive affect (PANAS) from baseline to 6-months (3.6±1.4, $P=0.05$) and 12-months (4.7±1.3, $P=0.003$), in addition to a mean decrease in perceived levels of depression

(HADS) from baseline to 6-months (-2.0± 0.7, *P*=0.043) and 12-months (-2.2±0.7, *P*=0.013). A significant decrease in BMI was observed from baseline to 6-months (mean change = -0.7kg/m^2 SD 1.7, *P*=0.016) and in self-reported weight loss (mean change = -2.6±0.8kg, *P*=0.014). No change was observed in HbA1c. Process evaluation observed high protocol fidelity and adoption by health professionals. Reasons given for successful implementation included a protocol integrated with diabetes care, minimal time requirements from health professionals, and skilled delivery of the intervention by an Exercise Health Psychologist. Several minor amendments were made to the intervention to increase support for participants with complex support needs. The 12-month intervention was delivered at a cost of GBP560 per participant.

Conclusions: Physical activity consultation, delivered by a skilled Exercise Health Psychologist, can be a feasible and effective method of supporting people with diabetes and multiple co-morbidities to increase their levels of physical activity and improve psychological wellbeing. Implementation and adoption by health professionals can be facilitated by developing interventions which translate readily into current diabetes care.

BACKGROUND

Diabetes is an international health problem with the global prevalence of diabetes in adults currently estimated at 285 million people (6.4%). This number is expected to exceed 430 million (7.7%) by the year 2030 with type 2 diabetes accounting for 90% of cases (1). The World Health Organisation predict diabetes-related deaths will double between 2005 and 2030 (2).

Physical activity has been shown to play an integral role in the management of adults with type 2 diabetes. Engaging in physical activity is known to improve insulin sensitivity, facilitate glucose uptake, reduce the progression of multiple diabetes-related complications, and reduce all-cause mortality (3). Physical activity is also known to have a positive effect on mental wellbeing and quality of life, important factors in the long-term management of chronic conditions (4). In addition to promoting physical activity, recent research suggests that small reductions in sedentary behaviour can benefit people with diabetes. Van Dijk et al (5) reported that in individuals with type 2 diabetes postprandial spikes were controlled by regular breaks from sitting. Despite the benefits of increasing physical activity and reducing sedentary behaviour the majority of adults with type 2 diabetes remain insufficiently active (6, 7).

Physical activity interventions based on a theoretical framework of behaviour change and tailored for individuals have shown to be effective in achieving greater physical activity and improving health outcomes (8). Incorporating techniques such as goal setting, problem solving, self-monitoring and decisional balance are important facilitators of physical activity behaviour change (9). A recent review of seventeen RCT's delivering behavioural interventions to increase physical activity in adults with type 2 diabetes found that theory based interventions using multiple behaviour change techniques resulted in significant improvements in both physical activity and health outcomes (8).

Physical activity consultation is one theory-based method of intervention delivery shown to increase levels of physical activity in people with diabetes (10-13). This approach provides participants with a one-to-one consultation, tailored to their stage of change via the application of behaviour change techniques, including: goal setting, self-monitoring, decisional balance, enhancing self-efficacy, problem solving, social support, and relapse prevention (14). Physical activity consultation can be an appropriate intervention for people with diabetes, who are known to exhibit lower levels of physical activity and greater barriers to participation than the general population (15, 16). Studies exploring physical activity consultation for people with diabetes report significant improvements in physical activity and positive effects on health outcomes when applied in a typical research environment. Higher levels of physical activity and improved health have been reported in the longer term, up to 24 months, showing some success at maintenance of behaviour change (17, 18). Guidelines for using physical activity consultation in people with diabetes are available (14), however, the feasibility of implementing these guidelines into everyday routine diabetes care has yet to be explored.

Despite the strong evidence base for physical activity and diabetes, the majority of physical activity interventions have been performed in a controlled research setting, with often resource intensive methods, short duration and lack of long-term follow-up (19, 20). Minimal information is available on how these interventions work when adapted and implemented within everyday practice (21, 22).

Multiple factors play a role in the implementation of interventions in everyday practice, including: funding, time constraints, resources, administration, communication and promotion (23). It is therefore important to identify the elements of implementation which are effective, and under what circumstances. Process evaluations are one such method. They explore the feasibility and effectiveness of interventions under real-world conditions. Guidelines on the use of process evaluations recommend that data should be collected to explore several key elements. These include: programme development and improvement; accountability to stakeholders; programme fidelity; gaps between programme design and delivery (24, 25). The findings of process evaluations help other researchers or health services develop a similar service. The use of process evaluations in the translation of research findings for effective clinical practice is increasing. However, a lack of consistent reporting of the evaluation findings remains an issue (26, 27). Adherence to guidelines set out by organisations such as the World Health Organisation (24) can help ensure publications report both reliable and *useful* data for fellow researchers and clinicians.

A limited number of process evaluations for physical activity within diabetes care have been performed (28-30). To our knowledge no process evaluation has been performed in the UK exploring the implementation of a physical activity intervention within routine diabetes care.

Aim

The aim of this process evaluation was to explore the feasibility, implementation and effectiveness of a 12-month pilot physical activity consultation service delivered for adults with diabetes in National Health Service (NHS) Grampian, Aberdeen, UK.

METHODS

A 12-month physical activity consultation service was developed for implementation within routine diabetes care. The intervention was designed for: a) delivery by an Exercise Health Psychologist[1] experienced in physical activity behaviour change; b) integration with other elements of routine diabetes care; and c) to reflect implementation with everyday practice as opposed to a typical research setting.

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[1] A psychologist qualified in both health psychology and sport and exercise psychology.

a) Description of the Physical Activity Consultation Service

Participants and Recruitment

Adults (>18yrs) with type 1 or type 2 diabetes were eligible to participate in the physical activity consultation service. Individuals with contraindications for physical activity were ineligible to participate, including individuals with unstable angina and other uncontrolled cardiovascular conditions. Promotion of the service was provided by a) posters, leaflets and promotion by health professionals in one hospital-based diabetes clinic and two general practices, b) the media (newspaper and radio advertisements), and c) leaflets and promotion by exercise leaders at local diabetes exercise classes. Interested patients were advised to self-refer by contacting the Exercise Health Psychologist directly via a telephone number provided. This method of promotion and recruitment was chosen to reach people with diabetes who were ready to change their physical activity behaviour, improve retention rates, and to minimise the input required by busy health professionals. Recruitment methods were timed appropriately to prevent a long waiting-list of interested participants. Further information was provided by the Exercise Health Psychologist via telephone prior to an initial physical activity consultation being arranged.

Physical Activity Consultation

The 12-month intervention (Figure 5.1) was based on physical activity consultation guidelines for adults with type 2 diabetes (14). In brief this intervention was guided by the Transtheoretical Model of Change (TTM). The TTM proposes that at any point in time an individual is represented by a ‘stage of change’ known as pre-contemplation, contemplation, preparation, action, or maintenance. The model involves the interaction of other factors, including: decisional balance, self-efficacy and ten identified ‘processes of change’ (31). During a physical activity consultation different behaviour change strategies are used depending on an individual’s stage of change to encourage them to initiate and maintain higher levels of physical activity. The behaviour change strategies used in this intervention protocol are supported by the recent Behaviour Change Technique Taxonomy by Michie et al (9). All consultations were delivered by an accredited Exercise Health Psychologist with qualifications and experience in both Health Psychology and Exercise Psychology. The Exercise Health Psychologist had access to a network of health professionals should specific diabetes-care advice be required.

Participants received an initial 30-min face-to-face consultation during which the Exercise Health Psychologist assessed each individual's stage of behaviour change for physical activity (described below). The consultation then proceeded based on each individual's stage of change and involved initial strategies such as discussing pros and cons of physical activity, and utilising *experiential* processes of change e.g. consciousness raising (31). Five follow-up consultations, over the first five month period, were offered to each participant via their chosen method of contact (face-to-face, email or telephone). The aim of these consultations was to support individuals to adhere to their behaviour change goals via the use of additional behaviour change strategies by promoting self-efficacy and incorporating *behavioural* processes of change e.g. counter-conditioning (31). Follow-up consultations were participant-led and therefore varied in format and duration depending on stage of change and the level of support required. Two further face-to-face 30-min consultations were undertaken at both 6-months and 12-months. Stage of change was re-assessed at each of these visits and subsequent discussion continued to use behaviour change strategies aimed at promoting maintenance of positive changes e.g. improving self-efficacy (31). During the latter phase (6 to 12-months) no formal contact with participants was made; however, participants were encouraged to contact the Exercise Health Psychologist for advice if needed.

Maintenance of long-term behaviour change was incorporated via the use of specific behaviour change strategies (e.g. relapse prevention) in addition to decreasing frequency of contact over time (32). At the end of the 12-month intervention, it was anticipated that participants would have gained knowledge and understanding of their physical activity behaviour to maintain positive changes. Participants were also provided with a resource detailing local physical activity opportunities.

Resources

Throughout the 12-month intervention participants were encouraged to increase their physical activity to meet the current recommendations of 30-mins of moderate physical activity on at least 5 days per week (3, 33). Participants were advised to choose activities they enjoyed, with participation in local diabetes exercise classes being recommended. Walking was also encouraged as a cheap and effective form of activity (34, 35). Pedometers (SilvaEx10) and step diaries were provided and participants were encouraged to self-monitor their daily step count and set achievable walking goals. A physical activity resource booklet detailing various local activity opportunities was provided.

Outcomes Measures

Standard demographic information was collected during the initial consultation to explore the characteristics of participants self-referring to the service. Data included age, gender, type 1 or type 2 diabetes, duration of diabetes, marital status, and socioeconomic status.

Additional outcome measures were collected to determine the effect of the physical activity consultation intervention on: a) physical activity levels, b) health outcomes, and c) psychological wellbeing outcomes. All outcomes were measured at baseline, 6-month and 12-month follow-up (Figure 5.1).

Appropriate measures were chosen to minimise the challenge of obtaining data in everyday practice. Change in physical activity level was measured using the International Physical Activity Questionnaire-Short Version (IPAQ-S) (36). The IPAQ-S has been shown to be a valid and reliable tool within the diabetes population and can be administered quickly within the time constraints of routine care (37, 38). The IPAQ-S assessed whether participants were achieving the current physical activity recommendations. The Exercise Health Psychologist assessed individual’s stage of change by asking “Would you say you are thinking about increasing your activity or ready to change/increase your activity?” and asking additional questions which assessed their motivation and confidence for increasing or maintaining their current level of physical activity.

Body Mass Index and HbA1c were obtained from routine check-up data stored on a central computer data system. In NHS Grampian patients with diabetes attend routine clinic reviews at least twice yearly with data recorded on a central computer data system. This provided a quick and simple mode of data collection regarding blood glucose control and weight loss. The Positive and Negative Affect Scale (PANAS) was used to collect information on participants' perceived quality of life (39). The Hospital Anxiety and Depression Scale (HADS) was used to detect changes in psychological distress related to participants' diabetes (40). Both questionnaires have been used previously in people with diabetes (41-43). Participants were also encouraged to monitor their change in weight and self-report this data at each follow-up consultation.

Data Analysis

Data were analysed using the statistical package IBM SPSS Statistics (Version 20). Change in the number of participants achieving the current physical activity recommendations from baseline to 6-month and 12-month follow-up was analysed using McNemar's Chi-square test. Change in psychological and health outcomes was analysed using repeated measures ANOVA to test the effect of the intervention over time (baseline, 6-months and 12-months follow-up). The results are reported as mean and standard deviation with intervention effect (P-value). Significance was set at $P<0.05$.

b) Description of the Process Evaluation

A process evaluation, guided by the World Health Organisation's Process Evaluation guidelines (24) and the RE-AIM evaluation framework (44), was performed by an independent colleague not involved in the delivery of the physical activity consultation service (LM).

Multiple process evaluation measures were collected on an on-going basis during the initial 20-months of the pilot service. Three semi-structured interviews were undertaken with the Exercise Health Psychologist delivering the intervention. The aim of these 1-hour face-to-face interviews was to explore issues of implementation and protocol fidelity. Additional qualitative insight was gained from local health professionals (n=10) and participants (n=6), via telephone interview, email correspondence or online survey, regarding their experience of the pilot service. Qualitative data were analysed for practical information related to the feasibility, implementation and adoption of the intervention. A session summary was recorded by the Exercise Health Psychologist following each physical activity consultation to provide data on the content of all sessions. A data input spread sheet was used to record multiple information, including: attendance, missed appointments, reasons for non-attendance, physical activity outcomes, psychological wellbeing and health outcomes. All session summaries and data input spread sheet were analysed for relevant process data. Quantitative outcome data were analysed as previously described. Additional numerical data is presented as percentage and number of participants.

RESULTS

Participant characteristics

A total of 51 participants enrolled in the pilot physical activity consultation service during the initial 20-months of recruitment. Enrolment was on an on-going basis and at the time of data analysis 47 participants had completed a baseline consultation, 37 participants had completed 6-month follow-up, and 30 participants had completed 12-month follow-up.

Participants had a mean age 60.3±10.0 years; mean BMI 33.3±6.9kg/m^2; 78.8% (n=34) had type 2 diabetes; 51.3% were female; 55.7% had multiple comorbidities e.g. peripheral neuropathy. The majority of participants (63.9%, n=30) were from the two greatest quintiles of deprivation as assessed by the Scottish Index of Multiple Deprivation. Seventy-two percent (n=34) were married. Mean years since diagnosis was 12.4±12.0 years. All participants were of Caucasian origin.

The majority of participants either self-referred after receiving an information leaflet from the diabetes clinic or the local diabetes exercise class (39.1%, n=18) or were referred by health professionals in primary or secondary care (34.8%, n=16). The remaining participants self-referred following a press release or by word of mouth (26.1%, n=12).

Attendance and participation

Attrition was 12.8% (n=6). One participant withdrew before the intervention started, 3 participants withdrew before 6 month follow-up, and 2 participants withdrew before 12 month follow-up. Reasons for attrition were ill health (n=3), work commitments (n=1), child care issues (n=1) and relocation (n=1). The remaining participants attended all three face-to-face physical activity consultations. The majority of initial consultation appointments proceeded as scheduled, with only 8 appointments rearranged due to poor weather, family commitments or other hospital appointments.

Between baseline and 6-month follow-up all participants received monthly contact with the Exercise Health Psychologist delivering the physical activity consultations. Preferred method of follow-up contact was telephone 46.7% (n= 21 of 45) and email 53.3% (n= 24 of 45). No participant chose face-to-face contact as their preferred method of monthly follow-up.

Physical activity outcomes

Obtaining detailed IPAQ data proved challenging within the time-constraint of the consultations. Rather than calculating and recording the estimated minutes per day spent in various intensities of physical activity and sedentary behaviour the Exercise Health Psychologist briefly discussed with participants and assessed whether they were achieving the current physical activity recommendations. The physical activity outcome was therefore amended to reflect participants who were and were not achieving the physical activity recommendations at baseline, 6-months and 12-month follow-up. There was a significant post-intervention increase from baseline to 6-months and 12-months in the number of participants achieving the current physical activity recommendations (21.3% vs 66.7% vs 60.5%; $P<0.005$) (Table 5.1).

Stage of physical activity behaviour change increased from baseline to 6-months in 75.7% (n=28) of participants. At baseline 93.6% (n=44 of 47) of participants were in the *contemplation* or *preparation* stage of change, compared with 83.8% (n=31 of 37) being in an *action* or *maintenance* stage of change at 6-month follow-up. At 12-months 80.6% of participants with data (n=25 of 31) remained in either an *action* or *maintenance* stage of change.

Psychological Wellbeing and Health Outcomes

Change in psychological wellbeing and health outcomes from baseline to 6-month and 12-month follow-up are presented in Table 5.1.

The Hospital Anxiety and Depression Scale (HADS) and the Positive and Negative Affect Scale (PANAS) were used to measure components of psychological wellbeing. Significant improvements were observed from baseline to 6-months in positive affect (mean change 3.6 SD 1.4, 95% CI -0.7, 7.2, $P=0.05$) which was maintained from baseline at 12-months (mean change 4.7 SD 1.3, 95% CI 1.5, 8.0, $P=0.003$). A significant improvement in perceived levels of depression was observed from baseline to 6-months (mean change -2.0 SD 0.7, 95% CI -0.5, -4.0, P=0.043) which was also maintained from baseline at 12-month follow-up (mean change -2.2 SD 0.7, 95% CI -0.4, -4.1, P=0.013). No significant changes were observed in perceived levels of anxiety or negative affect (Table 5.1).

HbA1c and BMI data were collected from usual-care notes on a centralised computer system. A significant decrease in BMI was observed from baseline to 6-months (mean change -0.7kg/m^2 SD 1.7, 95% CI -1.2, 0.1; P=0.016). A similar significant reduction was observed in self-reported weight from baseline to 12-months (mean change -2.6kg SD 0.8, 95% CI -0.4, -4.8, P=0.014, Table 5.1). No change was reported for HbA1c from baseline to 6-months (mean change 1.7mmol/mol SD 9.5, 95% CI -2.1, 5.4; P=0.368). An insufficient number of participants had their usual-care notes updated on the centralised computer system prior to 12-month follow-up, therefore unfortunately HbA1c and BMI data could not be reported at this time.

Components of the physical activity consultation

Identified barriers and facilitators for physical activity

The Exercise Health Psychologist delivering the intervention recorded a session summary following all baseline physical activity consultations. Barriers and motivators for physical activity behaviour change were discussed and recorded with each individual participant. Participants often gave multiple responses: 61 responses were reported for 46 participants. Weight loss was identified as the greatest motivator of physical activity behaviour change (59%, n=36), followed by improved control of diabetes (19.7%, n=12). Other motivators identified included: stress reduction, maintenance of functional mobility, improved social life, and increased energy for playing with grandchildren. Participants were also encouraged to identify barriers to physical activity behaviour change. Fifty-four responses were reported for 46 participants. Lack of motivation was reported as the greatest barrier (44.5%, n=24), followed by lack of time due to work commitments, child care or hobbies

(29.6%, n=16). Pain from co-morbidities was highlighted as a barrier in 11.1% (n=6) of responses. Other barriers identified included: a fear of hypoglycaemic episodes, cost, obesity, depression and a lack of local facilities (7.4%, n=4).

Social support for behaviour change

The Exercise Health Psychologist delivering the intervention discussed social support with participants at the initial physical activity consultation and recorded what form of support they had available. Responses (n=44) were collected by the session summary report. The majority of participants (52.3%, n=23) identified their spouse as the main support for their physical activity behaviour change, with other relatives (13.6%, n=6) or friends (11.4%, n=5) identified by other participants. Two participants identified a carer and a pet as their form of support. Six participants (18.2%) had no form of social support, mainly due to being widowed.

Implementation

Protocol fidelity

The Exercise Health Psychologist delivering the intervention was asked to keep a record of participant visits and a summary of session content to assess fidelity to the intervention protocol. Fidelity to the intervention content was observed with participants receiving all components of the intervention (including face-to-face physical activity consultations at baseline, 6-months and 12-months) and additional monthly follow-up contact via telephone, email or brief face-to-face meetings. A wide range of behaviour change techniques were used to support participants to change their physical activity behaviour. These included: goal-setting cards, problem solving sheets, the provision of pedometers and step diaries for self-monitoring of walking activity.

Three adaptations to the protocol were required to ensure effective delivery of the physical activity consultations in practice. Firstly, the 30-minute time slot allocated for the face-to-face physical activity consultations was insufficient. This limited the time available to complete the physical activity consultation in addition to collecting outcome measures. The Exercise Health Psychologist therefore performed 45-minute physical activity consultations. Second, many participants were of older age, had multiple co-morbidities and required more intensive support than the initial protocol outlined. It was highlighted by feedback from participants and the Exercise Health Psychologist that the gap of 6-months between the initial and follow-up consultation was too long for a sub-set of participants. An additional physical activity consultation at 3-months was therefore offered to those participants requiring greater support to change their physical activity behaviour. Four participants accepted the additional face-to-face consultation with the remainder opting for telephone and email support. Finally, the Exercise Health Psychologist added a follow-up telephone call one week after the initial physical activity consultation. The aim of this additional contact was to ensure that participants had taken on board the information and goal setting discussed in the initial consultation. This gave participants the opportunity to clarify any issues prior to undertaking their initial behaviour change goals.

Issues regarding implementation

Over the course of the pilot physical activity consultation service three semi-structured interviews were conducted with the Exercise Health Psychologist delivering the intervention. The aim of these interviews was to identify issues regarding implementation. Several key issues were identified.

Access to several local activity resources played a key factor in the success of the pilot service. In addition to good availability of local leisure facilities participants also had access to diabetes-specific activity sessions. Health led walks (independently funded by Paths for All Partnership) and diabetes exercise classes (independently funded by NHS Grampian and participant payment fees) were identified as two services integral to the physical activity consultation service. In particular, a high number of participants attended the diabetes exercise classes (n=26) which were highlighted as a source of social support, peer advice and diabetes education. The diabetes exercise classes were led by experienced, motivated and knowledgeable exercise leaders who provided on-going support and encouragement to participants.

Insight from the Exercise Health Psychologist delivering the intervention found pedometers particularly effective for self-monitoring and forming intentional behaviours. Participants used the pedometers to profile their baseline activity, set progressive and achievable goals, and increase their self-efficacy for physical activity behaviour change. It was also observed by the Exercise Health Psychologist that participants' HbA1c and BMI results were not updated on the central computer system as frequently as anticipated making interpretation of post-intervention health outcomes challenging. A lack of administration support was identified as the main barrier to on-going delivery of the pilot service. In addition to delivering the intervention the Exercise Health Psychologist was responsible for all paperwork and promotion within a limited time allocation of 4-11 hours per week. The initial 20-months of delivery were delivered within 4-hours per week, following which additional funding was received to support 11-hours delivery per week. Limited secretarial support was provided from 12-months onwards which facilitated efficient delivery of the pilot service.

Insight from participants and health care staff

Insight was gained from six participants who had completed the 12-month physical activity consultation service. Responses were included from participants who had (n=4) and had not achieved (n=2) greater physical activity levels or weight loss. Participant satisfaction with the intervention was high in both groups. Participants identified several factors that contributed to their positive experience of the pilot service. Firstly, the approachability and helpfulness of the Exercise Health Psychologist delivering the intervention was highlighted. Participants felt the Exercise Health Psychologist genuinely cared for their wellbeing and this encouraged them to adhere to their goals. Second, the provision of pedometers and step diaries was considered motivational, informative and useful. Participants enjoyed the instant feedback of the pedometers and gained confidence as their daily step count increased. Finally, participants who did not achieve greater physical activity levels or weight loss highlighted ill-health and impaired mobility as the main barrier. All participants found the intervention beneficial and would recommend the service to other people with diabetes.

Insight was gained from ten health professionals regarding their adoption of the pilot service within primary and secondary care. Responses were collected from GPs, practice nurses, dietitians and diabetes specialist nurses, each of whom were aware of the service and had patients attending the service. Responses were gained from a mixture of semi-structured interviews, online surveys and email correspondence. All health professionals agreed that the pilot service complimented current diabetes care. They attempted to promote the intervention to appropriate patients who they considered ready to change their physical activity behaviour. Some health professionals expressed disappointment upon learning that patients had often not attended the service. Health professionals adopted and promoted the pilot service for several reasons. They considered the intervention protocol to be of a high standard, the service integrated well with current diabetes care, referral to the service was not time-consuming, and positive feedback was received from patients attending the service. They also valued the expertise of the Exercise Health Psychologist and identified the important role she played in being a ‘champion’ for the service. Health professionals also valued the on-going communication and feedback provided by the Exercise Health Psychologist, which was often undertaken using existing networks of communication e.g. departmental meetings.

Cost of the physical activity consultation service

The intervention was funded by an endowment fund of NHS Grampian. The main cost of the physical activity consultation service was the staffing cost of the Exercise

Health Psychologist delivering the intervention (4-11hrs per week), in addition to the cost of the consultant diabetologist (0.5hrs per week) and health psychologist (0.5hrs per week) who provided on-going support and management of the service. The initial 4-month set-up phase, conducted prior to participant recruitment, was conducted at a cost of GBP3995. This stage involved the project team networking with health care colleagues, finalising the intervention protocol and promoting the new service. The main delivery phase, which at the time of analysis was 22-months duration, was undertaken at a cost of GBP19,254. During the delivery phase 242 individual participant contacts were made (GBP80 per participant contact). Based on participants receiving a total of 7 contacts throughout the intervention (3 face-to-face consultations and 4 monthly follow-ups) the estimated cost of providing the 12-month physical activity consultation intervention was GBP560 per participant.

Additional funding was provided by the Paths for All Partnership to purchase Silva-ex10 pedometers (n=100) at a cost of GBP1200. Additional resources were provided at no cost by the National Health Service Scotland, including venues to conduct the physical activity consultations and the production of promotion informational sheets. These are potential costs that should be considered for future interventions.

DISCUSSION

The 12-month pilot physical activity consultation service was delivered with high protocol fidelity, high retention rates, low attrition and positive feedback from both participants and adopting health professionals. The intervention was effective in achieving greater levels of physical activity, health benefits and psychological wellbeing.

Several aspects of the pilot physical activity consultation service may have contributed to the effectiveness of the intervention. Firstly, the intervention was delivered by an experienced Exercise Health Psychologist skilled in behaviour change techniques. Participants reported a strong rapport with the Exercise Health Psychologist. They identified the Exercise Health Psychologist's approachability, helpfulness and genuine concern for their wellbeing as an important factor in their experience of the intervention. The role of health psychologists in supporting physical activity behaviour change in diabetes care has not been previously explored. They can work alongside other diabetes care health professionals to provide an integrated approach to patient management. Their knowledge and skills in complex behaviour change may be beneficial for individuals with diabetes who require intense support due to multiple comorbidities (45).

Second, the individual approach of the physical activity consultation provided one-to-one support for many participants with complex support needs. This is supported by findings from the *Time2Act* study where participants received physical activity information, delivered either face-to-face or in written form via post. A control group received a standard information leaflet only (46). Overall, no significant difference between the intervention and control groups was found. However, a sub-group analysis of participants with low physical activity levels at baseline identified a significant increase in physical activity from baseline to 12-months in the group receiving the person delivered intervention only, suggesting that one-to-one support was most beneficial for individuals requiring additional support to change their behaviour. Despite the intensive format of the consultations being of benefit to participants it must be acknowledged in general that the individual approach of a physical activity consultation service is time-consuming and resource intensive (Napolitano & Marcus, 2002).

Participants also had the opportunity to gain further support from a group environment by attending the diabetes exercise classes. Group settings are known to provide peer motivation and support (47) and have been effective in achieving greater physical activity levels in adults with diabetes (48). This is supported by responses from participants and the Exercise Health Psychologist delivering the intervention which identified the diabetes exercises classes as a source of peer support, diabetes education and a social network for participants.

Third, flexibility in the method of monthly follow-up allowed participants to have autonomy over their preference for support. Participants were able to tailor their monthly follow-up to suit their individual circumstances. They also had the flexible option of contacting the Exercise Health Psychologist at any time between follow-ups for on-going advice. This flexible approach supported the on-going delivery of the service. The Exercise Health Psychologist had a limited 4-11hr time slot per week and the ability to contact participants via email or telephone allowed the service to continue at a comfortable rate without creating a back-log of participants waiting for face-to-face appointments.

Finally, the pilot service was integrated with other aspects of routine diabetes care such as dietary education. Consequently, the intervention was well received and adopted by health professionals within both primary and secondary care. This is reflected in the rate of referrals received from health professionals and the rate of self-referrals after participants were given a leaflet by a health professional. An integrated approach to patient management reflects the everyday setting of routine diabetes care where patients may receive similar information and advice from various sources. It was important for the intervention protocol to reflect this practice as opposed to replicating the strict methods of interventions delivered in a research setting. Translating interventions for implementation within everyday practice is essential to promote the delivery of effective and sustainable interventions (21, 22).

The Exercise Health Psychologist delivered the intervention within a limited 4-11hour per week time-slot. Appropriate recruitment methods were used to ensure that the intervention continued to operate at a comfortable pace without creating a long waiting list of eligible participants. Fifty-one participants enrolled in the service during the initial 20-months of recruitment. If, however, the Exercise Health Psychologist had been operating on a full-time basis the intervention would have had potential to recruit approximately 300 participants in the same time-frame.

The physical activity consultation intervention was based on a theoretical framework of behaviour change (31) and evidence-based guidelines for the delivery of physical activity consultation for people with diabetes (14). A range of behaviour change techniques, supported by the Behaviour Change Technique Taxonomy by Michie et al (19), were employed by the Exercise Health Psychologist. These included goal setting, problem solving, decisional balance, self-monitoring, and support to form intentional behaviours and improve self-efficacy. Insight from the Exercise Health Psychologist delivering the intervention identified the use of pedometers as particularly effective for self-monitoring and forming intentional behaviours. Pedometers were used by participants to set achievable daily step goals, record daily steps in a step diary, improve motivation for walking via instant feedback and improve confidence in their overall walking ability. Previous research has shown pedometers to be effective in achieving greater levels of physical activity in people with type 2 diabetes in both the short term and long-term (49, 50). Their feasibility in this sample of mainly older adults with multiple comorbidities is encouraging.

The 12-month intervention was effective in achieving significantly greater levels of physical activity in addition to significant improvements in psychological wellbeing (positive affect and depression) and health outcomes (BMI and self-reported weight). These are meaningful findings. Individuals with Type 2 diabetes, who are often sedentary and overweight/obese, are known to achieve metabolic improvements from small changes in physical activity (51). Improved levels of physical activity in this study were associated with a significant reduction in BMI and self-reported weight. BMI and weight reduction was below the recommended 5%-loss for clinically significant benefits (52). However, absence of 12-month HbA1C makes further interpretation of these clinical benefits challenging. Physical activity interventions undertaken in a research setting have found similar results for self-reported physical activity and BMI (8), however, there is limited data to support effectiveness once implemented within a routine care setting (27). This evaluation therefore demonstrated that real-world implementation can reflect the findings of efficacy studies. Physical activity interventions often focus on clinical outcomes (e.g. HbA1c), however, psychological outcomes are also important in diabetes management. For example, positive and negative affect are known to play a role in decision making therefore improving positive affect can help maintain behaviour change (53). Short bouts of brisk walking are known to increase positive affect (54) which supports the beneficial role of the pedometer in this pilot service. Even low intensity and unstructured physical activity has been shown to increase positive affect which is of particular benefit to older sedentary adults with diabetes and multiple comorbidities (55). No significant change was observed in HbA1c from baseline to 6-months. Unfortunately at the time of analysis for this PhD thesis data from 12-month follow-up was not available. In addition limited information was available on the central database on current medication type and dose. Therefore although no significant change was recorded in HbA1c from baseline to 6-months we cannot rule out that changes may have been made to medication.

Several minor but useful adaptations were made to the intervention protocol to ensure the effective and on-going delivery of the pilot service. Each of the adaptations increased the intensity of support being received by participants: a telephone call was added 1-week following the initial physical activity consultation; a 3-month face-to-face physical activity consultation was added for those participants identified as needing additional support; and the 30-minute physical activity consultations were increased to 45-minutes duration. An increased intensity of support and frequency of contact has been identified in previous research as an important factor in both achieving and maintaining effective lifestyle behaviour change (32, 56). A review of physical activity and dietary interventions in the general population found that maintenance of behaviour change was associated with interventions that included face-to-face contact, were greater than 6-months duration, included brief follow-up contact out with the main intervention component, and used greater than six behaviour change strategies (32). The physical activity consultation intervention achieved each of these criteria, contributing to a significant number of participants maintaining greater levels of physical activity at 12-month follow-up.

Usual care notes were utilised for the collection of some data including HbA1c and BMI. This method was chosen to reflect everyday practice where it is not always feasible to collect objective or time-consuming data. The Exercise Health Psychologist delivering the pilot physical activity consultation had a limited time allocation per week therefore usual care notes were a method of reducing the administration workload and allowing more time to be focussed on delivering the intervention. The use of usual care notes has been recommended by another diabetes study who identified that limited staff time was a barrier to data collection (57). Additional subjective methods were used to involve participants in the data collection process. This included the recording of self-reported weight. Participants spoke of increased confidence in their ability to achieve and maintain their behaviour change as they realised their clothes were feeling looser and their weight was reducing. Increasing self-efficacy in this manner is an important part of behaviour change (58).

The initial success of the pilot physical activity consultation service has led the adopting health service to fund an extension of the service to evaluate implementation and effectiveness over a longer period of time.

Strengths and limitations

This is the first process evaluation performed in the UK exploring the implementation of a physical activity intervention within routine diabetes care. Reporting bias was minimised by the evaluation being undertaken by an independent researcher not involved in the delivery of the intervention. A wide range of valuable and useful process information was reported. Several limitations of the process evaluation need to be addressed. Objective outcome data to assess changes in HbA1c and BMI were to be collected from ‘usual care notes’ on a central computer database. However, participant details were not always updated at the expected time interval of 6-months. Therefore the majority of outcome data used to assess effectiveness of the intervention was self-report, which may be influenced by socially desirable responses. This represents the practical challenges of implementing services within everyday practice. Although insight from participants and health professionals was confidentially collected by an independent researcher responses may have been influenced by their positive relationship with the Exercise Health Psychologist delivering the intervention.

CONCLUSIONS

This in-depth process evaluation demonstrated that it is feasible to implement an effective physical activity consultation service within routine diabetes care. Factors associated with the success of the intervention included: an intervention protocol integrated with current routine diabetes care; an experienced Exercise Health Psychologist skilled in delivering behaviour change sessions for participants with multiple barriers and co-morbidities; access to local leisure facilities, in particular, the availability of a diabetes specific exercise class; individual support in the form of face-to-face physical activity consultations; and the opportunity for participants to choose their preferred method of follow-up. The intervention protocol was amended to increase the frequency and duration of contact with participants who exhibited complex support needs. Limited admin support was identified as the key barrier to efficient delivery of the intervention. The findings of this process evaluation contribute to our knowledge and understanding of implementing feasible and effective physical activity interventions within everyday practice. In particular, the findings identify key facilitators and barriers for successful implementation which may inform the development, delivery and evaluation of future physical activity interventions within routine care for adults with diabetes.

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Figure 5.1. Physical activity consultation intervention timeline

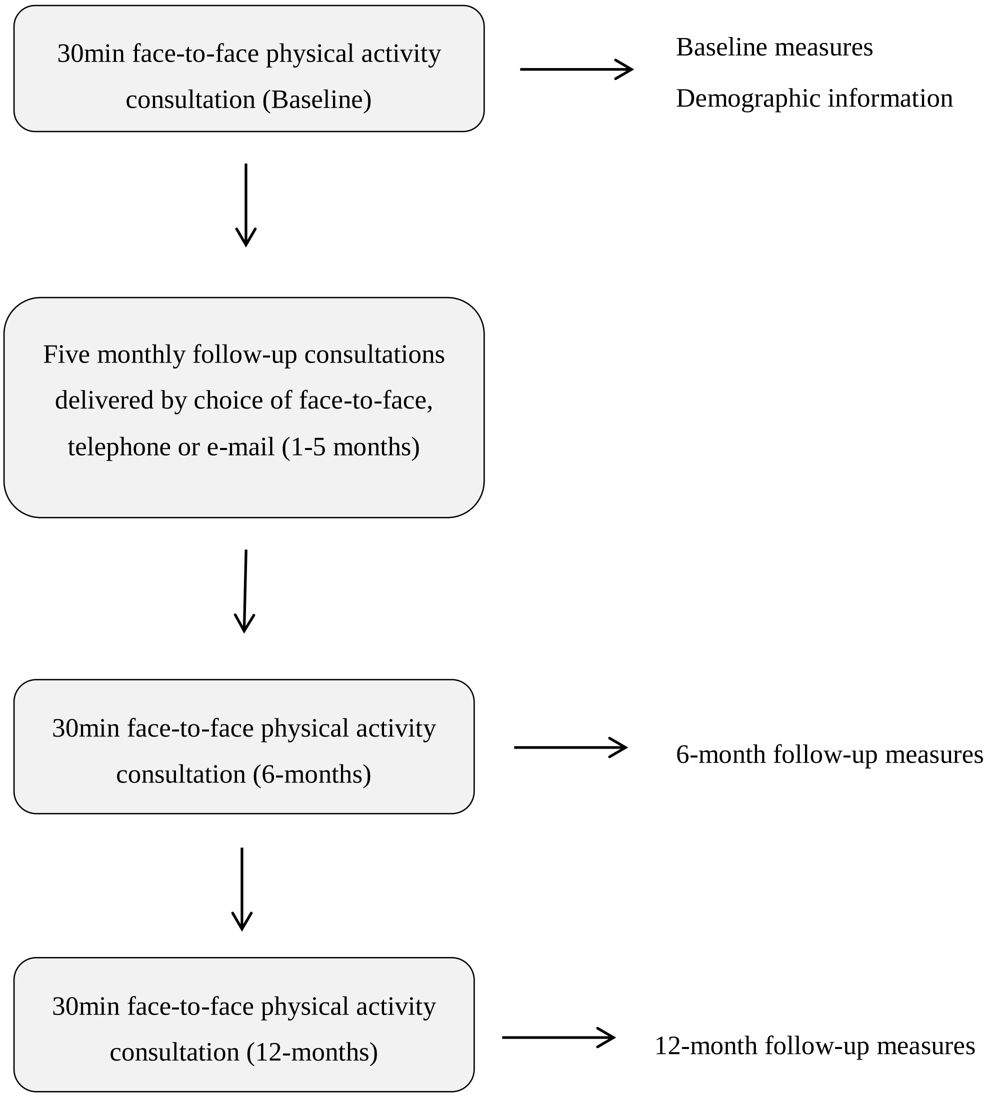

Table 5.1. Mean (SD) data for physical activity, PANAS, HADS, BMI, HbA1c and weight at baseline, 6 and 12-months

Outcome	*Baseline*	*6-months*	*12-months*	*Intervention effect (P-value)*
% of participants meeting the PA° recommendation	21.3%	69.2%	60.5%	0.02#*
Anxiety (HADS) (n=22)	5.4 ± 4.0	5.7 ± 4.9	4.7 ±3.6	0.259+
Depression (HADS) (n=22)	4.9 ± 3.7	2.9 ± 2.9	2.6 ± 2.5	0.018+*
Positive Affect (PANAS) (n=23)	29.3 ± 6.6	30.5 ± 9.0	34.1 ± 7.4	0.003+*
Negative affect (PANAS) (n=23)	16.9 ± 7.2	16.7 ± 7.6	14.5 ± 5.9	0.097+^
Self-reported weight (kg) (n=25)	97.2 ± 19.1	96.5 ±18.8	94.6 ±19.1	0.014+*
HbA1c (mmol/mol) (n=27)	63.5 ± 15.4	64.7 ± 14.9	~	0.368+
BMI (kg/m2) (n=22)	33.1 ± 6.3	32.4 ± 6.1	~	0.016+*

°Physical activity. #*P*-value was obtained from McNemar's Chi-square test. + *P*-value was obtained from a repeated measures ANOVA.
^ Approaching significance. * Significant result. ~ Insufficient data

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CHAPTER 6

Paper Four

The manuscript presented in Chapter 6 has been prepared for submission to the peer-reviewed journal, *Implementation Science*. The paper is based on the findings of this PhD research (Chapters 3-5), therefore submission of this manuscript is planned following publication of the corresponding Papers 1-3. The paper is presented using the structure and reference style of the intended publication.

This paper addresses research question 3 by providing recommendations to support the effective translation, implementation and evaluation of physical activity interventions within routine diabetes care.

Recommendations for the translation, implementation and evaluation of physical activity interventions within routine diabetes care

L Matthews, A Kirk, N Mutrie

ABSTRACT

Physical activity is known to be an important tool in the management of adults with Type 2 diabetes. Despite a strong evidence base little is known about how physical activity interventions work when delivered within routine diabetes care. More interventions are being translated for delivery within everyday practice, however, their associated publications often lack details on how they translated and implemented their interventions. Several tools are available to support the development and delivery of health interventions (e.g. the RE-AIM framework) but no such guidance is currently available for interventions which focus on diabetes management. The guidance outlined in this paper aims to provide useful and practical information to support the development of feasible and effective physical activity services for diabetes care. Recommendations are presented to support the three individual stages of: (1) *translation* of previous research findings, (2) *implementation* of practical intervention protocols and (3) *evaluation* of interventions in practice. Researchers and health professionals should use these recommendations to facilitate the future delivery and adoption of sustainable physical activity interventions within routine diabetes care.

BACKGROUND

Diabetes and physical activity

Type 2 diabetes is a global health problem. The World Health Organisation predict 387 million individuals (7%) will have Type 2 diabetes by the year 2030 [1]. Individuals with diabetes are living to an older age with multiple co-morbidities, it is therefore not surprising that the cost of managing diabetes places a heavy burden on global health services [2, 3]. Implementation of effective management strategies is needed to reduce the long-term burden of diabetes care.

Physical activity is an integral part of diabetes care. A strong evidence base supports the role of physical activity in improving clinical, health and psychological outcomes [4, 5]. Engaging in sufficient physical activity can improve insulin sensitivity and glucose uptake, reduce BMI, diabetes-related complications and all-cause mortality [5]. Physical activity is also known to have a positive effect on mental wellbeing and quality of life which are important factors in the long-term management of chronic conditions [6]. Recent research also suggests that small reductions in sedentary behaviour can control postprandial spikes in blood glucose [7]. Despite the potential benefits of increasing physical activity and reducing sedentary behaviour the majority of individuals with Type 2 diabetes are insufficiently active [8, 9]. Interventions are required to encourage individuals with Type 2 diabetes into active lifestyles that help manage their condition and improve their long-term outcomes.

Physical activity interventions tailored for individuals and based on a theoretical framework of behaviour change are known to be effective for increasing physical activity and improving health outcomes [10, 11]. We now know that incorporating techniques such as problem solving, goal setting, decisional balance and self-monitoring are important facilitators of physical activity behaviour change [11]. A recent review of seventeen RCT's delivering behavioural interventions to increase physical activity in adults with type 2 diabetes found that theory based interventions using multiple behaviour change techniques resulted in significant improvements in both physical activity and health outcomes [12].

Although the evidence base for the role of physical activity in Type 2 diabetes is strong, little is known about how physical activity interventions work when delivered within routine diabetes care [13, 14]. The translation and implementation of health interventions into everyday practice is a complex and challenging process. Multiple factors, which are not always present in controlled research studies, interact to create obstacles in the form of funding, resources, communication, time constraints and staff commitment [15-17]. Wider implementation of interventions is made more difficult by few studies providing details on how they translated and implemented their interventions [13, 18]. Therefore many lessons are yet to be learned about the complex transition from theory to sustainable practice [19]. The Medical Research Council's framework for the development and evaluation of health interventions highlights the importance of addressing several stages of intervention delivery to support long-term implementation [20].

There are three distinct stages of delivering a physical activity intervention within routine diabetes care: (1) translation of previous research findings, (2) implementation of a practical intervention protocol and (3) evaluation of how the intervention worked in practice. Translation involves adapting research findings to suit different populations and settings. Implementation refers to the process of delivering interventions within a specific context, and evaluation identifies what particular processes were successful or unsuccessful and under what circumstances [19, 21]. Widespread adoption of physical activity services within routine diabetes care is the ultimate goal. However, due to the journey from translation to sustainable delivery being a long and complex process we, as researchers and health professionals, need guidance on how to get there.

Why are these recommendations needed?

Despite physical activity interventions being translated for delivery within everyday practice their associated publications often lack details on the practicalities of implementation [13].

Researchers and health professionals need information regarding *how* the intervention worked in practice i.e. What challenges were identified with recruitment? How much did the intervention cost? What changes were required to the study protocol? Why did participants not complete the intervention? How was the intervention tailored to the population? However, publications typically focus on outcome results. In a review of 80 health interventions for the BMJ, Glasziou et al [22] found that 50% did not report sufficient information to enable the intervention to be effectively replicated. In addition, only 31% reported on fidelity to the intervention protocol. In general, publications often lack information on: recruitment, adherence, fidelity, staff training, resources, administration, and importantly qualitative insight from participants and staff. This type of information is essential for researchers and health professionals to effectively translate and implement physical activity interventions for different diabetes care settings.

Although several tools are available to help researchers and health professionals translate, implement and evaluate health interventions (e.g. the Medical Research Council framework [20], the World Health Organisation's Process Evaluation workbook [21], the RE-AIM framework [23], and the IMAGE Toolkit for the Prevention of Type 2 Diabetes in Europe [24]), no such guidance is currently available for interventions which focus on diabetes management. The guidance outlined in this paper brings together useful and practical information to assist researchers and health professionals develop feasible and sustainable physical activity services for diabetes care. The specific aim of this guidance is to provide recommendations and practical tips to support the three stages of *translation, implementation* and *evaluation* of physical activity interventions for routine diabetes care.

Who are these recommendations for?

These recommendations will be helpful to a wide range of professionals involved in diabetes care, including: researchers, policymakers, health service management, funders, GPs, practice nurses, diabetologists, diabetes specialist nurses, dietitians, diabetes educators, physical activity consultants and health psychologists. The guidance may also be useful to other professionals involved in the promotion of physical activity to adults with Type 2 diabetes and other conditions e.g. cardiovascular disease, obesity or stroke.

METHODS

The following recommendations are based on: (1) a systematic review of the current literature exploring the delivery of physical activity interventions within routine diabetes care [13] *[Thesis chapter 3]*; (2) a qualitative study exploring the views and opinions of key stakeholders involved in the promotion of physical activity information to individuals with Type 2 diabetes [25] *[Thesis chapter 4]*; (3) a Process Evaluation of a physical activity consultation service implemented within routine diabetes care [26] *[Thesis chapter 5]*; (4) current literature commenting on the translation, implementation and evaluation of physical activity interventions for individuals with Type 2 diabetes; and (5) other guidelines addressing similar recommendations for health interventions within everyday practice e.g. the Medical Research Council framework [20], and the World Health Organisation's Process Evaluation workbook [21], RE-AIM framework [23], and the IMAGE Toolkit for the Prevention of Type 2 Diabetes in Europe [24].

RECOMMENDATIONS FOR BEST PRACTICE

Recommendations are provided for three individual stages of intervention delivery within routine diabetes care: (1) translation of previous research findings, (2) implementation of practical intervention protocols, and (3) evaluation of intervention delivery. Each section discusses the current literature followed by a list of practical recommendations to support researchers and health professionals design and implement future interventions. Several recommendations relate to more than one stage of intervention delivery and therefore appear more than once. Table 6.1 provides an overview of the recommendations.

1. Translation of previous research findings

Although controlled research studies demonstrate efficacy of intervention methods they do not represent the best method of delivering the intervention to the wider population [27]. Efficacy studies are often associated with intensive resources and high costs which are challenging to sustain in the long-term [28, 29]. Translation of their research findings can therefore be a complex process. A range of potential factors are present in a natural environment, including: weather, funding, staff knowledge and experience, staff turnover and commitment, venue facilities, public transport, and time constraints [15, 17]. The current evidence base for physical activity and Type 2 diabetes explores some of these factors (e.g behaviour change techniques, frequency and intensity of interventions, and expected outcomes). However, many factors remain unknown (e.g. staff motivation, weather-dependent services, and administration support). Translation of current research findings must attempt to address these unknown factors to ensure new interventions are appropriate for the target population, setting and health care service.

Table 6.1. Summary of recommendations for the translation, implementation and evaluation of physical activity interventions for routine diabetes care

Translation	*Implementation*	*Evaluation*
1.1 Research the evidence base	2.1 Develop a financial plan	3.1 Plan the evaluation
1.2 Explore current practice and health care structure	2.2 Choose measureable outcomes	3.2 Choose appropriate outcome measures
1.3 Understand the target population	2.3 Identify a champion for the intervention	3.3 Collect qualitative data
1.4 Choose measureable outcomes	2.4 Improve retention rates by regular contact	3.4 Collect long-term follow-up data
1.5 Design feasible characteristics of protocol	2.5 Provide training and on-going support for intervention staff	3.5 Perform a cost evaluation
1.6 Form partnerships	2.6 Monitor fidelity to the intervention protocol	3.6 Publish the evaluation findings
	2.7 Adapt resources as needed	3.7 Do something with the evaluation findings
	2.8 Maintain communication with stakeholders	
	2.9 Integrate with current care	
	2.10 Streamline administration processes	

Few studies have addressed the translation of physical activity interventions for delivery within various settings. They reported that consideration of several factors was required, including:

- Reduction in the number and cost of resources and incentives [34-36].
- Strategies to enhance recruitment and retention of participants from low-income and diverse ethnic groups e.g. appropriate literacy levels and cultural focus of resources [16, 36, 37].
- Longer duration and follow-up intervals 13, 34, 38].
- Delivery by alternative intervention staff e.g. health students or peers [32, 37].
- A formative process, or pilot phase, to identify various factors which inform the design of the intervention [13].
- Intervention delivery by a multidisciplinary team [37, 40, 41].
- Outcome measures which represented delivery of an intervention within everyday practice [26, 42].
- The need to establish partnerships with community organisations to promote sustainability through on-going promotion, recruitment and administration [13, 26, 39].

These findings support recommendations for the translation of physical activity interventions within clinical practice. Estabrooks and Glasgow [43] presented three recommendations for translating physical activity interventions for a variety of medical conditions into a clinic-based setting.

- Firstly, it is essential to research and understand the health care structure in which the proposed intervention will be delivered.
- Secondly, promote successful delivery by addressing the finer details of the proposed intervention. The intervention should be planned in a flexible manner so that it may be adapted as required.
- Thirdly, form strong partnerships at the planning stage with other departments or organisations.

Based on the available literature six recommendations are presented below to support the effective translation of research findings into a tailored physical activity intervention (Table 6.1).

Recommendation 1.1 - Research the evidence base

- Explore the current literature on physical activity interventions for adults with Type 2 diabetes. A wide variety of methodologies exist covering a variety of settings (primary care versus community), behaviour change theories (Transtheoretical Model of Change versus Theory of Planned Behaviour), intervention approaches (individual versus group education), and modes of delivery (telephone versus face-to-face) [13].
- Consider protocols which demonstrate effectiveness and report methodology in sufficient detail to allow for replication and modification.
- Base interventions on theory and evidence-based practice but ensure flexibility is available where appropriate to reflect real-life participants and health care settings.
- Design a service that is feasible and can integrate with other services within your health service.

Recommendation 1.2 - Explore current practice and health care structure

- Ensure that you are familiar with the structure and procedures of the local health care structure. Several studies have achieved this goal by performing a scoping qualitative phase prior to protocol development [13].
- Use this data to inform the design of the intervention protocol. Although the protocol will be founded on evidence-based practice it must also reflect the capacity of current health care resources. For example, a physical activity intervention delivered by dietitians within routine diabetes care will not be feasible if the dietitians are already struggling with high workloads and unmotivated to undertake additional responsibilities.

Recommendation 1.3 – Understand the target population

- Undertake preparatory research to understand the local community. Explore the socio-economic and cultural range of the population, their available facilities, and any previous interventions that have been undertaken in the past [24, 39].
- Tailor the intervention methodology to the target population. Consider factors such as culturally relevant resources, methods of follow-up contact (telephone vs email), and appropriate literacy levels of written resources [13]. Choose appropriate eligibility criteria that do not exclude those individuals in most need of support.
- If a venue is required ensure it accessible by your target population, has adequate facilities and availability of public transport and parking.

Recommendation 1.4 - Choose appropriate measureable outcomes

- Objective measures provide accurate data, however, they are often expensive and time-consuming for both the participant and intervention staff (e.g. accelerometry). Subjective measures are typically inexpensive and quick to administer but can be affected by desirability bias [44]. Choose appropriate measures that fit within the current budget and health care practice [14].
- Many translated interventions use simple measures of physical activity (e.g. pedometers, step diaries or International Physical Activity Questionnaire) in conjunction with standard health outcomes, which may be available from usual care notes (e.g. routine HbA1c and BMI) [26].
- To promote the likelihood of adoption and sustainability of the intervention choose measurable outcomes that are inexpensive, simple to administer, quick to obtain and easy to evaluate.

Recommendation 1.5 - Design feasible characteristics of the intervention protocol

- Several additional factors should be considered when translating an intervention for routine diabetes care. First, establish a realistic timeframe for various stages of the intervention, including: development, networking, promotion, recruitment, staff training, implementation, modifications, follow-up, evaluation and reporting.
- Second, reflect current health care practice by integrating the intervention protocol with other aspects of routine diabetes care (e.g. dietary education) [26]. Various health professionals may provide varying degrees of physical activity information to individuals and establishing continuity of care is essential for on-going support.
- Finally, link the protocol with local resources and facilities to establish continuity of care and communication for participants [26]. Ensure that other facilities, such as local leisure centres, are aware of the physical activity intervention and can signpost appropriate individuals [25].

Recommendation 1.6 - Form partnerships

- Establish alliances with other health care departments, community organisations and support networks during the early planning phase of the intervention [26].
- Strategic partnerships can help support the delivery, adoption and sustainability of interventions by providing an additional source of recruitment, promotion, feedback and administration support [13, 24, 42].

2. Implementation of intervention protocols

Complex factors interact to make implementation within everyday health practice challenging. For example, there are competing influences from policy makers, health service management, health professionals, administration support, external partnerships and service users which create difficult environments in which to implement and sustain new health interventions [19, 45].

Pagoto [46] identified several key issues regarding the implementation of lifestyle interventions within the wider population. Primarily, the cost of interventions is often the main challenge. Funding is typically available for the duration of an intervention but a lack of funding is a barrier for on-going delivery, even for successful interventions which report high adoption by professionals [40]. Other issues include delivery of interventions by unmotivated staff, loss of an intervention ‘champion’, and a reliance on research staff to implement the intervention.

Similar findings have been found within the diabetes population where implementation can be affected by staff characteristics such as motivation for intervention delivery, personal attitudes towards physical activity and knowledge of behaviour change [47]. A qualitative study by Matthews et al [25] explored the insight of health professionals in the delivery of physical activity promotion to adults with Type 2 diabetes. It was demonstrated that some health professionals were reluctant to undertake further training or accept greater responsibility within their role. Health professionals reported a lack of time for effective physical activity promotion and often felt lacking in confidence and skills for physical activity behaviour change. Several studies identified the role of intervention ‘champions’ [26, 40].

A limited number of physical activity interventions for adults with Type 2 diabetes have reported details of implementation [13]. A systematic review by Matthews et al [13] found inconsistent reporting across 12 studies providing details of implementation e.g. fidelity to the intervention protocol was reported in only 50% (n=6) of articles. However, practical and useful information was provided by those few publications which did address the issue. In particular, appropriate behaviour change techniques, supported by theoretical frameworks of behaviour change (e.g. Transtheoretical Model of Change), were employed in all interventions. Behaviour change training for a variety of individuals delivering the intervention was also reported in the majority of articles.

Retention of participants has been identified as a challenge in everyday practice [37]. Several interventions have employed successful strategies to improve retention rates, such as immediate contact with participants who fail to attend a scheduled appointment [26, 40]. Other challenges with retention may relate to lack of follow-up data rather than attrition. Klug et al [42] reported low attrition but unfortunately lacked follow-up data due to poor data collection by individuals delivering the intervention. The reasons for limited data collection are unknown but may relate to lack of time, lack of motivation, unsuitable measures or other unknown factors. Follow-up data will be essential to obtain on-going funding and support for the intervention therefore strategies to support the collection of follow-up data should be considered during the planning stage of new interventions.

Interventions *integrated* within routine diabetes care may facilitate implementation. Significant physical activity and health outcomes have been demonstrated by interventions integrated within routine diabetes care [26]. Integration with routine care can be accomplished by health care staff across various disciplines discussing, promoting and signposting individuals with diabetes towards physical activity interventions and resources [26, 40].

Although the knowledge and skill of individuals delivering physical activity interventions is an important factor, an ability to engage and build rapport with participants is also essential. [26, 40]. Intervention staff who can relate to the target population, whether via ethnicity, culture, language or local knowledge, have also been identified by participants as beneficial [37, 39, 40].

Administration problems may present barriers to implementation. On-site support may be required for interventions delivered across several venues [42]; individuals delivering the interventions need support to prepare paperwork and resources [26]; high staff turn-over or staff illness requires methods for training alternative staff; and delays may be caused by paperwork issues for staff employment [40]. Strategies to minimise these barriers will benefit implementation.

Finally, unlike controlled research studies, interventions delivered within everyday practice can be adapted as needed to suit the requirements of participants or departmental resources. Flexibility in intervention methods may be important to retain participants with complex support needs who are at high risk of drop-out [26].

Based on the available literature ten recommendations are presented below to support the efficient implementation of physical activity interventions translated for delivery within routine diabetes care (Table 6.1).

Recommendation 2.1 - Develop a financial plan

- A feasible funding plan which considers sustainability as an option is recommended prior to initial delivery of the intervention.
- Ensure multiple factors are accounted for including: staff costs and staff turnover, resources, training, promotion, measurable outcomes and other factors unique to the intervention or local health care structure [46].

Recommendation 2.2 - Choose appropriate outcome measures

- As highlighted in Recommendation 1.4 choose appropriate outcome measures that reflect everyday practice. Measures are needed to assess effectiveness of the intervention and for on-going evaluation.
- The likelihood of sustaining a new intervention is improved by providing evidence of its feasibility, effectiveness and affordability.

Recommendation 2.3 - Identify a 'champion' for the intervention

- Health departments have competing demands for funding and services therefore new interventions can benefit from a 'champion' to represent, network and promote the service [26].
- The role of the 'champion' may evolve naturally, however, it could be useful to gain support from an individual who is well-known and respected within the intervention setting [25].

Recommendation 2.4 - Improve retention rates via regular contact

- There are many reasons for participants missing an appointment. Do not assume they are no longer interested. Place an immediate telephone call to participants who miss an appointment. Discuss with them any barriers to participation and reschedule another appointment if appropriate.
- If resources allow, consider contacting participants after their initial appointment to support any fears or anxieties they have regarding their ability to take part [26]. Maintain regular and brief contact with participants over the duration of the intervention and follow-up.
- Choose appropriate methods which are not time-consuming or costly such as telephone call or email. Use intervention staff who are motivated to engage with the intervention. Participants also respond well to staff who are friendly, approachable and knowledgeable [26].

Recommendation 2.5 - Provide training and on-going support for intervention staff

- A range of health care staff are capable of delivering physical activity interventions within diabetes care including: dietitians, diabetes specialist nurses, health psychologists, GPs and others [13, 25]. Adults with Type 2 diabetes have also effectively delivered physical activity interventions for their peers following the provision of behaviour change training [39].

- Behaviour change training is important to ensure all individuals have the necessary knowledge and skills to confidently deliver the intervention in practice. It is important, however, that training workshops are engaging and provide attendees with clinical information that they can relate to their patients [25].
- Choose appropriately motivated and committed intervention staff. It may be possible to highlight appropriate individuals via informal discussion, formal interview or department-wide training sessions. Avoid using staff who appear unmotivated for the intervention or physical activity promotion.
- Maintain motivation and engagement of intervention staff by providing on-going support. Strategies include staff feedback sessions, involving staff in modifications, presenting staff with positive findings from the intervention, and providing additional training and support when appropriate [25, 26, 46].

Recommendation 2.6 - Monitor fidelity to the intervention protocol

- Monitoring fidelity to the protocol informs several aspects of implementation. It demonstrates components of the intervention which do not translate well into practice, in addition to identifying aspects of the intervention which work particularly well. Second, it may highlight components of the intervention which are more time-consuming or costly than anticipated. Finally, monitoring fidelity can highlight on-going training and support needs of intervention staff.
- Protocol fidelity can be monitored by several methods, including: observation of the intervention, session records, and qualitative insight from intervention staff. It may be useful to use more than one method to assess fidelity. Qualitative insight, in particular, can be useful in understanding the complex process of delivering an intervention within everyday practice [20].

Recommendation 2.7 - Adapt resources as needed

- Unlike controlled research studies interventions implemented within routine diabetes care have flexibility in their intervention methods. It is important to facilitate smooth implementation throughout the duration of an intervention therefore make adaptations as required [26].
- For example, if an outcome measure is time-consuming consider alternatives or if a written resource is challenging for participants of low-literacy consider revising the resource.

Recommendation 2.8 - Maintain communication with stakeholders

- Promotion of the intervention can be facilitated by maintaining communication with various stakeholders. This may be informal such as intervention staff being visible at intervention venues, passing on positive feedback from participants, or opportunistic discussion of the intervention with colleagues. More formal methods of communication include presentation of intervention progress at staff meetings, emailing updates throughout the local health service and community, and maintaining a constant supply of promotional materials to relevant departments, partnerships and venues [26].
- Continue to utilise partnerships for support with recruitment, promotion, delivery or administration. Remember that partnerships should benefit from the intervention therefore use strategies to enhance and sustain partner relations. Make sure that external partners have a supply of promotional material and explore what on-going input they may require to support the intervention [13].

Recommendation 2.9 - Integrate with current care

- Enhance continuity of patient care by linking with other aspects of diabetes management, local facilities and local resources. Adults with Type 2 diabetes receive overlapping information from a variety of services. It is important that these services are aware of each other and have relevant resources to share [26].

- If *referral* is a method of participant recruitment ensure that all services and local facilities are familiar with the referral procedure.

Recommendation 2.10 - Streamline administration procedures

- Promote smooth implementation by reducing the burden of administration. Plan to use resources and measures that are not time-consuming to prepare or evaluate.
- Define roles and responsibilities within the intervention team so that individuals have a clear understanding of their administration duties which may include: telephone calls to participants, written letters to GPs, printing of questionnaires, delivery of pamphlets and posters, or data input [25].

3. Evaluation of intervention delivery within routine diabetes care

Substantial time and resources are invested in the translation and implementation of new health interventions. It is therefore essential to evaluate *how* interventions work in practice. Formal evaluation can identify many factors associated with delivery of an intervention, including: adaptations needed to the intervention protocol, cost of the intervention, challenges of recruitment or retention, reasons for attrition, support needs of intervention staff and administration problems. Identifying these processes facilitates improvement of interventions and strengthens their potential for sustainability [21, 46, 48].

Several tools are available to support researchers and health services perform effective evaluations. These include tools such as *process evaluation* [21, 49, 50], the

RE-AIM framework [23], and the Medical Research Council's *framework for the development and evaluation of health interventions* [20].

Although such tools exist to support the evaluation of health interventions a limited number of evaluations have been reported for physical activity and diabetes [13, 37, 51].

Matthews [26] performed a process evaluation of a physical activity consultation service within routine diabetes care. The evaluation identified several issues, some of which were addressed and re-evaluated during the duration of the intervention. Many participants were elderly and presented with complex support needs therefore the 30-minute face-to-face consultations were of insufficient duration to effectively address these needs. The duration of each consultation was subsequently increased to 45-minutes. Initial evaluation also discovered that the scheduled 6-month gap between face-to-face consultations was considered too long by participants and intervention staff. This was despite participants receiving on-going monthly follow-up via telephone or email. The protocol was therefore amended to accommodate this finding and an additional face-to-face consultation at a 3-month interval was offered to those participants identified as having complex support needs. Administration issues were highlighted as the main challenge to efficient delivery and secretarial support was consequently added to reduce the administration burden. Qualitative insight from health care staff found that they viewed the intervention positively due to its integration with other aspects of routine diabetes care e.g. dietary advice. This facilitated communication between different health care specialities and promoted patient-centred care.

The cost of an intervention is typically one of the main barriers to sustainability. Evaluation of an intervention can help adopters understand the short-term and long-term costs of delivering the intervention within their setting. Evaluations can identify the costs of various components associated with delivery of the intervention, including: staff, resources, recruitment, promotion and equipment [53]. Unfortunately very few interventions have published such information, making it difficult to understand the potential cost of delivering physical activity interventions within routine diabetes care.

In general, a lack of reporting of evaluation findings remains a problem [13, 49]. Matthews et al [13] propose that future physical activity interventions for people with diabetes should focus on reporting the process of implementation, guided by resources such as the Medical Research Council framework [20], the World Health Organisation's Process Evaluation Workbook [21], or the RE-AIM evaluation framework for health interventions [23], to ensure consistent reporting of both reliable and useful information.

Based on the literature seven recommendations are presented below to help researchers and health professionals effectively evaluate physical activity interventions within routine diabetes care (Table 6.1).

Recommendation 3.1 - Plan the evaluation

- Approach an evaluation as an integral part of the intervention process by developing the evaluation plan simultaneously with the intervention protocol. This may help highlight specific components of the intervention which need assessed.
- Conduct evaluations as part of an on-going and interactive process i.e. evaluate early, mid and follow-up stages of the intervention and make amendments where appropriate [26].
- Evaluations which are undertaken as an after-thought may be less structured and lack sufficient data to fully understand the processes which took place [54, 55].

Recommendation 3.2 - Choose appropriate outcome measures

- In addition to Recommendations 1.4 and 2.2 measure short-term and long-term outcomes.
- Tudor Locke et al [56] recommend having an expectation of what these outcomes should be at various stages of the intervention process. For example, short-term measures may show an increase in physical activity

levels, compared with long-term measures which may show a plateau in physical activity levels.

Recommendation 3.3 - Collect qualitative data

- Understanding the complex process of translating and implementing physical activity interventions within routine diabetes care cannot be achieved via quantitative data alone. Qualitative insight is necessary to gain an understanding of the challenges faced in everyday practice [46].
- It is useful to gain qualitative insight from a variety of people involved in interventions including participants with both successful and unsuccessful outcomes, and staff involved in the development and delivery of the intervention [26]. Where possible it may also be helpful to gain feedback from ‘non-responders’ and ‘drop-outs’ to understand the reasons for non-participation.

Recommendation 3.4 - Collect long-term follow-up data

- Promote sustainability of interventions by demonstrating to adopters and funders that the intervention is feasible and effective in the long-term. Develop an evaluation plan which incorporates inexpensive and simple methods of collecting relevant data at long-term follow-up. Plan these outcomes and time-points in advance.
- Few physical activity interventions for diabetes have published findings from long-term follow-up therefore little is known about the effect of interventions following the initial delivery phase.

Recommendation 3.5 - Perform a cost evaluation

- Adopters and funders need to know about the short-term and long-term costs of an intervention. It is important to provide sufficient detail on running costs of delivery including staff salaries, staff training, resources and equipment.

- As with any new venture immediate costs tend to be greater than the on-going long-term costs. Therefore, Estabrooks and Glasgow [43] also recommend detailing the long-term costs and benefits to the wider population.

Recommendation 3.6 - Publish evaluation findings

- Evaluation findings benefit not only the immediate intervention team, but also a wider population of researchers and health professionals. Publication of such findings allows others to learn from the both the positive and negative aspects of intervention delivery.
- To date, limited information has been published on physical activity interventions delivered within routine diabetes care, of which findings have been inconsistent and difficult to compare with other studies [13].
- Adherence to guidelines such as the World Health Organisation's Process Evaluation workbook, the RE-AIM framework and the Medical Research Council framework, can help ensure publications report both reliable and *useful* data for fellow researchers and health professionals.

Recommendation 3.7 - Do something with the evaluation findings

- Evaluation findings are only useful if they are acted upon. Consider the challenges and processes that did not work well and apply changes that improve intervention delivery. For example, if a particular baseline questionnaire was too time-consuming and hindered delivery consider using a shorter but effective alternative.
- The evaluation will have identified particular aspects of the intervention that worked well. Don't forget to use these positive evaluation findings to your advantage. Use positive data to reinforce the intervention, promote adoption and market the intervention.

SUMMARY

Many lessons have yet to be learned about translating physical activity interventions into sustainable services for adults with Type 2 diabetes. This can only be achieved by more publications describing the translation, implementation and evaluation processes of their interventions.

The practical steps discussed in this paper support the translation, implementation and evaluation of physical activity interventions within the complex context of everyday practice. Researchers and health professionals should use these recommendations to facilitate the future delivery and adoption of sustainable physical activity interventions within routine diabetes care.

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CHAPTER 7

Discussion

7.1 Chapter outline

This thesis was presented in the form of four individual manuscripts (Chapters 3 to 6). Detailed discussion of each individual study's research findings was included within the relevant chapters. This final discussion chapter will therefore provide a brief integrated summary of the overall research findings and discuss how these findings address the original research questions set out at the beginning of the thesis.

The chapter will begin with an overview of the research questions, followed by a brief summary and discussion of the key findings from each chapter. An overall discussion of the main findings is then provided. The strengths and limitations of the overall thesis are presented followed by an outline of how this research has contributed to the literature on the implementation of physical activity services for the management of Type 2 diabetes. The chapter concludes with suggestions for future research and a dissemination plan for the research findings.

7.2 Overview of research questions

The aim of this PhD was to contribute to the translational gaps in the literature regarding physical activity promotion within diabetes care by addressing the following research questions.

Research Question 1: What issues are associated with the design, translation and implementation of physical activity interventions for people with Type 2 diabetes in an everyday routine care setting?

- Chapter 3 presented a systematic review of the literature exploring the translation and implementation of evidence based physical activity interventions into everyday practice.
- Chapter 5 reported the findings from an in-depth process evaluation of a pilot physical activity consultation service delivered within routine diabetes care in NHS Grampian.

Research Question 2: What are the views and attitudes of health professionals towards current and future physical activity promotion within routine diabetes care?

- Chapter 4 provided qualitative insight from health professionals regarding their experiences of physical activity promotion, and their thoughts on the future delivery of physical activity promotion within NHS Scotland.

Research Question 3: What are the key elements for effective delivery of physical activity services within routine diabetes care?

- Chapter 6 presented recommendations for the translation, implementation and evaluation of physical activity interventions for people with Type 2 diabetes. These recommendations were based on findings from Chapter 3-5.

7.3 Summary of key points arising from each chapter

7.3.1 Points arising from Chapter 2: Literature Review

Chapter 2 presented the strong evidence base for the role of physical activity interventions in the management of adults with Type 2 diabetes. A wide variety of methods were employed by previous studies to promote physical activity to individuals with Type 2 diabetes. These included: individual physical activity consultations; telephone delivered interventions; group-based approaches;

pedometer-based interventions; and structured physical activity programmes. All styles of intervention were shown to be effective for promoting physical activity levels within the diabetes population. Discussion of the research findings, however, identified several important gaps in the literature.

- A lack of information was provided by studies regarding the most effective strategies to recruit and retain participants with Type 2 diabetes in physical activity interventions. In general, studies reported limited information on the overall reach of interventions, in particular, to participants from high-risk groups (e.g. high risk ethnic groups, low socioeconomic backgrounds, and sedentary individuals).
- Although tailored physical activity interventions, based on theoretical components of behaviour change, have been shown to support people with Type 2 diabetes to increase their levels of physical activity, the majority of interventions have been of short duration and lacked long-term follow-up. Only a few studies employed behaviour change strategies to promote maintenance of physical activity long-term.
- There was a lack of information relating to the adoption of physical activity interventions by health professionals or health services. Insight is required from health professionals to understand their experiences of delivering physical activity promotion to people with Type 2 diabetes.
- The majority of studies did not report on the practicalities of implementing physical activity interventions for individual with Type 2 diabetes. There was limited information on: behaviour change training received by individuals delivering the interventions; fidelity to intervention protocols; insight from staff delivering the interventions; or insight from participants receiving the intervention.

Overall, the literature review identified that few studies reported the type of information needed to inform the future development of physical activity interventions for translation and implementation within routine diabetes care.

7.3.2 Points arising from Chapter 3

Chapter 3 presented a systematic review exploring the delivery of physical activity interventions for adults with Type 2 diabetes. Despite the strong evidence base for the role of physical activity in the management of Type 2 diabetes a limited number of physical activity interventions have been translated into everyday practice. The systematic review aimed to address this issue by reporting the findings of studies in which a physical activity intervention had been delivered within routine diabetes care. Following a comprehensive search of the literature twelve articles were found reporting process data related to components of the RE-AIM framework: Reach, Effectiveness, Adoption, Implementation and/or Maintenance.

Detailed analysis of the twelve articles identified a number of important points for consideration when developing physical activity interventions for delivery in everyday practice.

- *Reach*: The use of computerised records, external organisations and tailored recruitment may help to maximise intervention reach and uptake.
- *Effectiveness*: A range of methods can be employed to gain positive physical activity behaviour change, including: diabetes clinic, telephone or community settings; individual or group counselling sessions; and intervention delivery by peers, health professionals or research staff . Adults with Type 2 diabetes may respond to interventions differently, therefore, the flexibility of using various approaches tailored to the individual may be beneficial in achieving positive outcomes. Future interventions should also consider the use of routine-care notes to overcome the challenge of collecting time-consuming outcome data during participant consultations (e.g. BMI, HbA1c).
- *Adoption*: A network of external organisations can play a positive role in the delivery and adoption of physical activity interventions. However, it is important to identify and support organisations which are both motivated and culturally appropriate to the intervention.
- *Implementation*: Tailoring resources and intervention delivery to the target population plays a positive role in achieving high rates of uptake, participant

satisfaction and physical activity outcomes. Future interventions should undertake preparatory social marketing of the local diabetes population to ensure interventions are tailored and implemented effectively.

- *Maintenance*: The majority of studies were of short duration (1-3 months) and lacked long-term follow-up (>12 months). Future interventions should evaluate the effect of maintenance strategies on behaviour change by including long-term follow-up.

Importantly, the systematic review highlighted the limited number of publications reporting on the translation and implementation of physical activity interventions for adults with Type 2 diabetes. This paper concluded that future publications should consider using a standardised tool, such as the RE-AIM framework, to support the reporting of consistent and useful information that will help other researchers and health professionals deliver physical activity services within diabetes care.

7.3.3 Points arising from Chapter 4

Chapter 4 presented a qualitative manuscript exploring the insight of health professionals regarding the current and future provision of physical activity promotion within routine diabetes care. Health professionals play an integral role in the physical activity behaviour change of adults with Type 2 diabetes. However, the provision of physical activity advice within routine diabetes care remains low. This paper therefore aimed to gain insight from health professionals to inform the development of future practice.

Responses were collected from participants (n=23) in two individual phases: an online survey (Phase One), which aimed to gain insight from a range of health professionals across all Health Boards in Scotland; and an in-depth qualitative stage (Phase Two), which explored the experiences of health professionals via semi-structured interviews. Qualitative responses were analysed using Interpretative

Phenomenological Analysis and categorised into themes and sub-themes. Four key findings were identified following detailed analysis.

Firstly, there was a lack of structure for physical activity promotion within routine diabetes care. In particular, several barriers were identified by health professionals, including:

- Confusion regarding access to physical activity promotion resources.
- A lack of referral route for physical activity support.
- Ill-defined roles for health professionals involved in routine diabetes care.
- Pressures of time constraints and clinical priorities.

Secondly, although behaviour change training for health professionals was highlighted as important the current provision of training was considered ineffective:

- Disease-specific training (e.g. diabetes versus stroke) led to health professionals receiving repetitive and non-motivating physical activity information.
- Information provided during training workshops was not sufficiently engaging or sufficiently clinical to reflect practice.
- Some health professionals attended behaviour change training workshops reluctantly and with a negative attitude.

Thirdly, a clinical focus on diabetes management acted as both a barrier and facilitator for physical activity promotion by health professionals:

- A focus on achieving health outcomes via medication and diet reduced the time available to consider and promote physical activity as a management tool.
- Achieving a positive clinical outcome in certain patients was considered a facilitator when health professionals could directly relate physical activity to a specific clinical benefit.
- Improvements in behaviour change training could support health. professionals to directly relate physical activity to clinical outcomes.

Finally, several issues were identified by health professionals regarding the future provision of physical activity promotion within routine diabetes care:

- Access to a behaviour change specialist was recommended (e.g. physical activity consultant, exercise referral scheme).
- Care should be taken to avoid information overload for patients, especially individuals newly diagnosed with Type 2 diabetes.
- Physical activity provision would benefit from being made a priority health service target.
- Health professionals with credibility and influence should act as ‘champions’ for physical activity to support the integration of physical activity within routine diabetes care.

Based on these key findings **s**everal recommendations were presented for improving the future delivery of physical activity advice to individuals with Type 2 diabetes. These included: (1) having a key member of staff responsible for physical activity promotion; (2) access to a referral route for physical activity support e.g. Exercise Referral Scheme or physical activity expert; (3) improved format of behaviour change training to engage health professionals with more clinical and diabetes-specific information; (4) linking the delivery of physical activity promotion with clinical outcomes; and (5) using ‘champions’ to raise the profile of physical activity within the health service and linking it with current policy frameworks. This paper concluded that incorporating these recommendations will improve the long-term outcomes of individuals with Type 2 diabetes via increased physical activity promotion by health professionals.

7.3.4 Points arising from Chapter 5

Chapter 5 presented a detailed process evaluation of a physical activity consultation service delivered within NHS Grampian, Scotland. The aim of this process evaluation was to explore the feasibility, implementation and effectiveness of a physical activity consultation service for adults within routine diabetes care. The 12-month physical activity intervention was developed by a consultant diabetologist, health psychologist and exercise health psychologist for delivery within a pilot area of NHS Grampian, Aberdeen, Scotland. Participants received an initial 30-minute face-to-face consultation, monthly follow-up consultations for 6-months (face-to-face, e-mail, or telephone), and further face-to-face consultations at 6 and 12-months. Consultations were guided by behaviour change strategies, tailored to stage of change, and delivered by an experienced exercise health psychologist. Various outcome measures were collected to evaluate the feasibility, implementation and effectiveness of the intervention. Recruitment was performed on an on-going basis. The service was delivered within a limited 4-11hr time allocation per week and during the initial 20-months of recruitment 51 participants had enrolled in the service. Baseline characteristics showed participants had: a mean age of 60.9 ± 10.2 years; BMI 33.1 ± 6.9; 51.2% female; 83.7% had Type 2 diabetes; 55.8% had multiple co-morbidities. A detailed evaluation of the physical activity consultation service identified several key issues for on-going implementation of the service.

Feasibility: The physical activity consultation service was a feasible method for delivering physical activity promotion to adults with diabetes.

- The exercise health psychologist delivering the intervention was able to undertake sufficient tasks within the limited 4-11 hour time slot per week to maintain efficient delivery of the service (e.g. promotion, consultations and paperwork).
- Participants, many of whom had complex support needs, responded well to the individual approach of the physical activity consultations.
- The intervention was considered a welcome addition to diabetes care by other health professionals due to being integrated with other aspects of diabetes management.

Effectiveness: The intervention was effective for increasing levels of physical activity and improving health outcomes and psychological wellbeing in those participants who had completed 6-month and 12-month follow-up.

- A significant increase was observed from baseline to 6-months and 12-months in the number of participants achieving the current physical activity recommendations (21.3% vs 66.7% vs 60.5%; $P<0.005$).
- A significant increase was observed from baseline to 6-months in positive affect (mean change 3.6 SD 1.4, 95% CI -0.7, 7.2, $P=0.05$) which was significantly greater from baseline at 12-months (mean change 4.7 SD 1.3, 95% CI 1.5, 8.0, $P=0.003$).
- A significant decrease in perceived levels of depression was observed from baseline to 6-months (mean change -2.0 SD 0.7, 95% CI -0.5, -4.0, $P=0.043$) which was also maintained from baseline at 12-month follow-up (mean change -2.2 SD 0.7, 95% CI -0.4, -4.1, $P=0.013$).
- A significant decrease in BMI was observed from baseline to 6-months (mean change -0.7kg SD 1.7, 95% CI -1.2, 0.1; $P=0.016$). A similar significant reduction in self-reported weight from baseline to 12-months (mean change -2.6kg SD 0.8, 95% CI -0.4, -4.8, $P=0.014$).
- No significant change was observed for HbA1c, negative affect or perceived levels of anxiety.

Implementation: Evaluation of the delivery process identified many interesting and useful findings to support future adaptations to the intervention.

- The role of the exercise health psychologist delivering the intervention was integral to the success of the physical activity service. Participants reported strong rapport with the exercise health psychologist who was also identified as being skilled, knowledgeable and approachable.
- High levels of adoption were demonstrated by health care staff. This was due to the intervention being integrated with current diabetes care and requiring minimal time input from staff.
- Many participants had multiple co-morbidities therefore several amendments were made to the intervention protocol to address the additional support needs of the sample. These included: (1) the addition of a telephone call 1-week following the initial physical activity consultation; (2) the addition of a 3-month face-to-face physical activity consultation for those participants

identified as needing additional support; and (3) an increase in the duration of consultations from 30-minutes to 45-minutes.

- Although the physical activity consultation service used an individual approach, participants also had the opportunity to gain further support from a group environment by attending local diabetes exercise classes. These were identified as a source of peer support, diabetes education and a social network for participants.
- Insight from the exercise health psychologist delivering the intervention identified the use of pedometers as particularly effective for self-monitoring and forming intentional behaviours. Pedometers were used by participants to set achievable daily step goals, record daily steps in a step diary, improve motivation for walking via instant feedback and improve confidence in their overall walking ability.
- Usual care notes were used to collect participant outcome data on BMI and HbA1c. When these clinical notes were regularly updated on the main computer system they were a useful method of data collection.

This in-depth process evaluation demonstrated that it is feasible to implement an effective physical activity consultation service within routine diabetes care. Factors associated with the success of the intervention included: an intervention protocol integrated with current routine diabetes care; an experienced health psychologist skilled in delivering behaviour change sessions for participants with multiple barriers and co-morbidities; access to local leisure facilities, in particular, the availability of a diabetes specific exercise class; individual support in the form of face-to-face physical activity consultations; and the opportunity for participants to choose their preferred method of follow-up. The intervention protocol was amended to increase the frequency and duration of contact with participants who exhibited complex support needs. Limited administrative support was identified as the key barrier to efficient delivery of the intervention. The findings of this process evaluation contribute to our knowledge and understanding of implementing feasible and effective physical activity interventions within everyday practice. In particular, the findings identified key facilitators and barriers for successful implementation which may inform the development, delivery and evaluation of future physical activity interventions within routine care for adults with diabetes.

7.3.5 Points arising from Chapter 6

Chapter 6 presented recommendations for the translation, implementation and evaluation of physical activity interventions for routine diabetes care. Recommendations were primarily based on the findings of this PhD research (Chapters 2-5), in addition to findings from the current literature and comparable guidelines on the implementation of health interventions.

The literature review (Chapter 2) and systematic review (Chapter 3, Paper One) demonstrated that despite many physical activity interventions being translated for delivery within everyday practice their associated publications often lack details on the practicalities of implementation. Researchers and health professionals need practical and useful information in order to effectively deliver sustainable physical activity interventions for different diabetes care settings. Although several tools exist to support the delivery of health interventions into everyday practice no guidance is currently available for interventions which focus on diabetes management. The specific aim of this guidance was to provide recommendations and practical tips to support the three individual stages of intervention delivery within routine diabetes care: (1) translation of previous research findings; (2) implementation of practical intervention protocols; and (3) evaluation of intervention delivery. Based on the current literature and findings of this PhD research the following recommendations were presented.

Translation: Although controlled research studies demonstrate efficacy of intervention methods they do not represent the best method of delivering the intervention to the wider population. Translation of their research findings is complex, however, the process can be facilitated by adhering to the following recommendations:

- 1.1 Research the evidence base
- 1.2 Explore current practice and health care structure
- 1.3 Understand the target population
- 1.4 Choose measureable outcomes
- 1.5 Design feasible protocol characteristics
- 1.6 Form external partnerships

Implementation: Complex factors interact to make implementation within everyday health practice challenging. Health care departments each have a unique combination of staff and resources, influenced by competing influences from a range of stakeholders. Implementation of an intervention will therefore rarely be perfectly replicated in different departments. However, the following recommendations have been identified as positive factors that support the process:

- 2.1 Develop a financial plan
- 2.2 Choose appropriate measureable outcomes
- 2.3 Identify a champion for the intervention
- 2.4 Improve retention rates by regular contact
- 2.5 Provide training and on-going support for intervention staff
- 2.6 Monitor fidelity to the intervention protocol
- 2.7 Adapt resources as needed
- 2.8 Maintain communication with stakeholders
- 2.9 Integrate with current care
- 2.10 Streamline administration processes

Evaluation: Substantial time and resources are invested in the translation and implementation of new health interventions. It is therefore essential to evaluate *how* these interventions work in practice. Researchers and health professionals should utilise appropriate evaluation tools (e.g. the RE-AIM Framework), in conjunction with the following recommendations, to perform informative and useful evaluations of new physical activity interventions within routine diabetes care.

- 3.1 Plan the evaluation
- 3.2 Choose appropriate outcome measures
- 3.3 Collect qualitative data
- 3.4 Collect long-term follow-up data
- 3.5 Perform a cost evaluation
- 3.6 Publish the evaluation findings
- 3.7 Do something with the evaluation findings

The practical steps presented in this paper support the translation, implementation and evaluation of physical activity interventions within the complex context of everyday practice. Researchers and health professionals should use these recommendations to facilitate the future delivery and adoption of sustainable physical activity interventions within routine diabetes care.

7.4 Integrated discussion of the key findings

Key findings from each chapter presented in this thesis demonstrate that delivery of physical activity interventions within routine diabetes care is a complex and difficult process. Researchers and health professionals face challenges in various stages of intervention delivery, including issues related to the translation of other research findings, implementation of intervention protocols within practice, and on-going evaluation of intervention delivery. In particular, Chapter 6 addressed the original research questions of this PhD by integrating the findings of the thesis into a practical and useful set of recommendations for future practice.

Many findings were highlighted throughout this thesis and these have been discussed in detail within the discussion section of each manuscript. However, it will be helpful to emphasise several of the most informative findings.

Firstly, one of the main findings of this research was the lack of reporting in published studies on the practicalities of translating and implementing physical activity interventions within routine diabetes care. A vast amount of funding is provided globally to develop and deliver evidence-based physical activity interventions for diabetes care (e.g. from funders including Diabetes UK, Diabetes Australia Research Trust, American Diabetes Association). It is therefore surprising that minimal evaluations of their delivery are available (Matthews, Kirk, et al., 2013). Chapter 5 addressed this gap in the literature by providing a detailed and informative process evaluation of a physical activity consultation intervention delivered within routine diabetes care. Preparation of the manuscript was guided by the Medical Research Council Framework for the development and evaluation of health interventions (2008), the RE-AIM framework (Glasgow et al., 1999) and the World Health Organisation's Process Evaluation workbook (World Health Organisation, 2000). The content of the manuscript therefore described in detail a wide range of processes including: reach and effectiveness of the intervention, adoption by health professionals, protocol fidelity, running costs, and challenges and successes of implementation. Researchers and health professionals should therefore find sufficient information to inform the development and delivery of their own physical activity consultation interventions for routine diabetes care. In particular, the information provided within the evaluation enables fellow researchers and health professionals to see what adaptations were needed to the intervention *following* implementation, and why.

Secondly, several findings identified in the earlier stages of this research were subsequently applied and explored by the latter stages of research. In particular, the literature review (Chapter 2) identified physical activity consultation as one of several methods for effectively promoting physical activity to individuals with Type 2 diabetes. This was further explored by the process evaluation in Chapter 5 where the intervention demonstrated improvements in physical activity, psychological wellbeing and health outcomes. The intervention did not, however, strongly demonstrate clinically significant results and was intensive in relation to staff time and resources. The individual approach of physical activity consultation may be beneficial for individual with complex support needs but may not be an appropriate or feasible method within overall routine diabetes care. As highlighted by the literature review it is one of several methods shown to effectively promote physical activity to individuals with Type 2 diabetes and as further highlighted by recommendations in Chapter 6 health professionals should carefully choose interventions that reflect and compliment the structure of their department. Findings from the qualitative phase of this thesis (Chapter 4) demonstrated the complexity of delivering physical activity promotion that suits addresses the insight of health professionals e.g. some health professionals were of the opinion that a physical activity expert would be a beneficial addition to their department, compared with other health professionals who felt they should have the main responsibility for physical activity promotion. Chapter 4 also highlighted, however, the need to support health professionals with high quality behaviour change training to facilitate their skills in physical activity consultation. It is important to reiterate that the method of physical activity consultation was explored in Chapter 5 due to an opportunity that arose with NHS Grampian. This thesis does not necessarily promote physical activity consultation as the single best method of physical activity promotion within routine diabetes care. The process evaluation did, however, demonstrate its utility in improving physical activity, psychological wellbeing and health outcomes in individuals with Type 2 diabetes. Other intervention methods highlighted in the literature review (Chapter 2) may also produce similar results and it is therefore important to (i) explore these methods with detailed process evaluations and (ii) encourage health care departments to choose an intervention which reflects the structure and staff capacity of their department.

Other issues identified earlier in this thesis were explored by latter stages of research. For example, the systematic review of the literature (Chapter 3) highlighted the positive role of utilising existing networks for the recruitment, promotion and administration of interventions (Matthews, Kirk, et al., 2013). The project team who designed the physical activity consultation service for NHS Grampian based their intervention protocol on this finding (Chapter 5). They utilised existing networks with the local Diabetes Managed Clinical Network and on-going routes of communication between primary and secondary care to promote the intervention. This facilitated the delivery of official communication and reduced the burden of promotion on the small project team. Another example is the finding from the qualitative study of health professionals (Chapter 4) which suggested having a key member of staff responsible for physical activity promotion and access to an official referral route for physical activity advice were two potential methods of improving future care. Again, the design of the physical activity consultation service (Chapter 5) addressed both of these findings. The intervention provided health professionals and individuals with diabetes with an official source of physical activity promotion, overseen by one individual member of staff (the exercise health psychologist). This provided continuity of care. Another example is a second finding from the qualitative study of health professionals (Chapter 4) which suggested that having a *'champion'* for physical activity, preferably an individual with credibility and influence, could support the integration of physical activity promotion within routine diabetes care. Three champions were identified in the process evaluation of the physical activity consultation service in NHS Grampian (Chapter 5). Their enthusiasm and on-going promotion of the intervention led to strong support and adoption by health professionals in both primary and secondary care. Finally, the pilot physical activity consultation service which was the focus of the process evaluation in Chapter 5 has been granted additional funding by NHS Grampian. The aim of the funding is to continue the implementation of the physical activity service with a view to on-going evaluation and long-term adoption. This relates back to the Medical Research Council's framework for the development and evaluation of health interventions (2008) (introduced in Chapter 1). Ultimately the process of intervention adoption does not end simply by it *being* adopted but rather through a cyclical process of on-going evaluation, translation and promotion. This successful funding outcome conveniently demonstrates the on-going and challenging nature of translational and implementation research.

Overall, this thesis has presented a detailed exploration of the delivery of physical activity interventions within routine diabetes care. Not only do the findings demonstrate that the process of delivering effective and sustainable services is complex but they also offer recommendations to improve and support future practice. Chapter 6, which outlined recommendations for the translation, implementation and evaluation of physical activity interventions within routine diabetes care, will be a valuable resource for other researchers and health professionals embarking on the development of future services.

7.5 Limitations of the thesis and implications for future research

The various stages of research performed for this PhD were designed with strong methodology and undertaken with a conscientious approach. However, as with all studies this research has various limitations that need to be addressed. These limitations are acknowledged below with suggestions of how to address these limitations in future research.

7.5.1 Generalizability of the research findings

A significant portion of this PhD research was undertaken in Scotland which is a Western developed country with an estimated diabetes prevalence of 4.7% of the population (n=247,278) (Scottish Diabetes Survey Monitoring Group, 2012). Individuals with Type 2 diabetes in Scotland are managed in either primary care or secondary care depending on the complexity of their condition. However, the provision of routine diabetes care varies between countries. This limits the generalizability of this PhD research to other health care systems. It is worth noting though that Chapter 4 highlighted key health professionals in diabetes care as GPs, nurses, consultant endocrinologists and dietitians. Other health care systems, which use similar health professionals within diabetes care, may therefore find these PhD findings useful and informative. All twelve articles found by the systematic review (Chapter 3) were also undertaken in developed countries. This is a reflection on the lack of publications reporting process information from interventions undertaken in developing countries. This is an area for future research and the publication of evaluation findings in both developed and developing countries is encouraged.

7.5.2 Methodological limitations

All methodological approaches have their strengths and limitations. These have been discussed in more detail within the individual manuscripts of Chapters 3-6. A brief summary of the overall limitations and how they affect the final findings of this research are presented here.

A large portion of the research presented in the thesis was of a qualitative or evaluative nature (Chapters 4-5). Although strong methodological approaches were used the influence of the researcher on data interpretation must be acknowledged. Chapter 4 explored the experiences of health professionals in the delivery of physical activity promotion via the qualitative method of Interpretative Phenomenological Analysis (Smith, 1996). This method provides a rich analysis of themes and narratives and is a useful choice for understanding the views of a specific group of participants. Chapter 5 presented an in-depth process evaluation of a physical activity consultation service delivered within NHS Grampian. Interview transcripts for this study were analysed using thematic analysis. As with all qualitative analysis the data must be subjectively interpreted by the researcher therefore it is possible that the personal views and experiences of the researcher influenced the data collection and data analysis process (Silverman, 2005, 2011). Steps were taken to minimise this researcher-bias by one researcher (LM) performing all data collection and data analysis, followed by several researchers independently reviewing and analysing the interview transcripts. This strengthened the qualitative concepts of *trustworthiness* and *credibility* (Lincoln & Guba, 1986).

There may also be a response-bias from individuals participating in the qualitative aspects of research. In Chapter 4, participants who accepted the invitation for a semi-structured interview were motivated to share their experiences on physical activity promotion. They may have stronger opinions on this topic than their peers who declined to participate. In Chapter 5, insight from participants and health professionals may have been influenced by their positive relationship with the exercise health psychologist delivering the intervention. Steps were taken to minimise this response-bias by data collection and data analysis being undertaken by a researcher (LM) independent of their work environment or intervention. Another limitation of the process evaluation (Chapter 5) was the role of the exercise health psychologist in the collection of subjective data. This included assessing participants' stage of change and providing information on fidelity to the initial intervention protocol. It must be acknowledged that researcher/reporting bias may be present.

7.6 Strengths of the thesis and contribution to the field

This thesis addresses significant gaps in the literature (identified in Chapter 2) and provides practical and useful information to promote the potential of physical activity promotion within routine diabetes care (Chapters 3-6).

Extensive research has addressed the implementation of physical activity interventions in relation to diabetes *prevention* (Lindstrom et al., 2010). However, to my knowledge this is the first substantial body of work to focus on the broader aspects of intervention delivery for the *management* of Type 2 diabetes. This is a critical step in the progress of translational research for physical activity interventions within routine diabetes care.

The contribution this research makes to the literature is demonstrated by several of the findings already being published and presented to a peer-reviewed audience. The systematic review presented in Chapter 3 has been published in the journal *Translational Behavioral Medicine* (Matthews, Kirk, et al., 2013). Several abstracts from Chapter 3 and Chapter 5 have been presented at national and international conferences including the *International Congress on Physical Activity and Public Health* (Matthews, Kirk, MacMillan, & Mutrie, 2012) and *Diabetes UK* (Matthews, MacMillan, Kirk, & N, 2013; McCallum et al., 2013). The remaining findings from the thesis are either currently under peer-review or awaiting submission to a peer-reviewed journal.

The chapters presented in thesis have several strengths that should be acknowledged. Firstly, the systematic review (Chapter 3) highlighted the absence of publications detailing implementation of physical activity interventions within the UK. Chapter 5 of this thesis presented the first process evaluation performed in the UK exploring the implementation of a physical activity intervention within routine diabetes care.

Secondly, strong methodology was used to ensure that all qualitative research undertaken for this thesis exhibited *trustworthiness* and *credibility* (Lincoln & Guba, 1986). All data collection and data analysis was performed by the same researcher (LM) before being independently reviewed and analysed by research colleagues. Chapter 4, in particular, provided rich qualitative insight from health professionals on the delivery of physical activity promotion within routine diabetes care, from which several recommendations were made to improve future physical activity promotion.

And thirdly, this thesis has focussed on the practical issues of translating, implementing and evaluating physical activity interventions within routine diabetes care. The majority of previous research has focused on the effectiveness of interventions on physical activity outcomes, health benefits and psychological parameters. This is one of the first substantial bodies of work to address the practical issues of intervention delivery within everyday practice.

7.7 Recommendations for future research and practice

The findings of this research have provided valuable recommendations for the translation, implementation and evaluation of future physical activity interventions for routine diabetes care. However, progress in the delivery of effective and sustainable interventions will be limited until more researchers and health professionals publish useful findings from their evaluations. It is recommended that future studies continue to examine and report on the processes of intervention delivery within routine diabetes care.

Further qualitative research is needed to explore the insight of individuals with Type 2 diabetes on physical activity promotion. Their experiences may provide useful data to inform the development of future services within routine diabetes care.

Chapter 5 provided detailed and informative insight from health professionals involved in routine diabetes care. However, this research was conducted in Scotland and further exploration of health professionals' experiences in other countries will provide additional insight to inform future practice.

Future studies should include information on the funding and running costs of physical activity interventions within everyday practice. This type of information is essential to promote adoption by health care departments.

Importantly, the first step following completion of this PhD will be to promote the recommendations presented in Chapter 6. Research findings that are not disseminated to the wider research community are essentially redundant. Therefore a dissemination plan has been developed to promote these recommendations to a global audience. This includes utilising existing networks such as: the Physical Activity and Health Alliance; Global Advocacy for Physical Activity; International Society for Physical Activity and Health; Scottish Diabetes Research Network; Diabetes UK; online social networks and other relevant organisations. All findings from this thesis will be submitted for peer-reviewed publication and presentation at national and international conferences.

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Appendix 1: Ethical approval from the University of Strathclyde

University of Strathclyde
Humanities & Social Sciences

SCHOOL OF PSYCHOLOGICAL SCIENCES & HEALTH

11th October 2013

Dear Sir/Madam,

RE: "*Physical Activity Services for Adults with Type 2 Diabetes*"

In my capacity as chair of the School of Psychological Sciences and Health Ethics Committee I am writing to confirm that the study entitled '*Physical Activity Services for Adults with Type 2 Diabetes*", which is being conducted by Ms **Lynsay Matthews** (lynsay.matthews@strath.ac.uk), and Dr Alison Kirk (alison.kirk@strath.ac.uk), has received full ethical and sponsorship approval (ethical approval was obtained on 24th November 2011). If you have any further questions about this project, please do not hesitate to contact me.

Kind regards,

Susan Rasmussen

Dr Susan Rasmussen

Chair of the School of Psychological Sciences and Health Ethics Committee

The place of useful learning

Appendix 2: NHS Grampian letter of access

Research & Development

Foresterhill House Annexe
Foresterhill
Aberdeen
AB25 2ZB

NHS
Grampian

Dr Lynsay Matthews
Physical Activity and Sport
School of Psychological Sciences
and Health
Sports and Arts Building
University of Strathclyde
Jordanhill Campus
76 southbrae Drive
Glasgow
G13 1PP

Date 10 April 2012
Enquiries to Joanne Rodger
Extension 55847
Direct Line 01224 555847
Email joanne.rodger@nhs.net

Dear Dr Matthews

Letter of access for research

This letter confirms your right of access to conduct research through NHS Grampian for the purpose and on the terms and conditions set out below. This right of access commences on 10/04/12 and ends on 01/09/14 unless terminated earlier in accordance with the clauses below.

You have a right of access to conduct such research as confirmed in writing in the letter of permission for research from this NHS organisation. Please note that you cannot start the research until the Principal Investigator for the research project has received a letter from us giving permission to conduct the project.

The information supplied about your role in research at NHS Grampian has been reviewed and you do not require an honorary research contract with this NHS organisation. We are satisfied that such pre-engagement checks as we consider necessary have been carried out.

You are considered to be a legal visitor to NHS Grampian premises. You are not entitled to any form of payment or access to other benefits provided by this NHS organisation to employees and this letter does not give rise to any other relationship between you and this NHS organisation, in particular that of an employee.

While undertaking research through NHS Grampian, you will remain accountable to the University of Strathclyde but you are required to follow the reasonable instructions of Mary McCallum of this NHS organisation or those given on his behalf in relation to the terms of this right of access.

Where any third party claim is made, whether or not legal proceedings are issued, arising out of or in connection with your right of access, you are required to co-operate fully with any investigation by this NHS organisation in connection with any such claim and to give all such assistance as may reasonably be required regarding the conduct of any legal proceedings.

NHSG letter of access for university researchers who do not require an honorary research contract
Version 1

Page 1 of 2

You must act in accordance with NHS Grampian policies and procedures, which are available to you upon request, and the Research Governance Framework.

You are required to co-operate with NHS Grampian in discharging its duties under the Health and Safety at Work etc Act 1974 and other health and safety legislation and to take reasonable care for the health and safety of yourself and others while on NHS Grampian premises. You must observe the same standards of care and propriety in dealing with patients, staff, visitors, equipment and premises as is expected of any other contract holder and you must act appropriately, responsibly and professionally at all times.

You are required to ensure that all information regarding patients or staff remains secure and *strictly confidential* at all times. You must ensure that you understand and comply with the requirements of the NHS Confidentiality Code of Practice (http://www.dh.gov.uk/assetRoot/04/06/92/54/04069254.pdf) and the Data Protection Act 1998. Furthermore you should be aware that under the Act, unauthorised disclosure of information is an offence and such disclosures may lead to prosecution.

You should ensure that, where you are issued with an identity or security card, a bleep number, email or library account, keys or protective clothing, these are returned upon termination of this arrangement. Please also ensure that while on the premises you wear your ID badge at all times, or are able to prove your identity if challenged. Please note that this NHS organisation accepts no responsibility for damage to or loss of personal property.

We may terminate your right to attend at any time either by giving seven days' written notice to you or immediately without any notice if you are in breach of any of the terms or conditions described in this letter or if you commit any act that we reasonably consider to amount to serious misconduct or to be disruptive and/or prejudicial to the interests and/or business of this NHS organisation or if you are convicted of any criminal offence. Your substantive employer is responsible for your conduct during this research project and may in the circumstances described above instigate disciplinary action against you.

NHS Grampian will not indemnify you against any liability incurred as a result of any breach of confidentiality or breach of the Data Protection Act 1998. Any breach of the Data Protection Act 1998 may result in legal action against you and/or your substantive employer.

If your current role or involvement in research changes, or any of the information provided in your Research Passport changes, you must inform your employer through their normal procedures. You must also inform your nominated manager in this NHS organisation as well as the Research and Development Office.

Yours sincerely

Jane Lloyd
Human Resources Team Leader, NHS Grampian

cc: R&D office at NHS Grampian
HR department of the substantive employer

NHSG letter of access for university researchers who do not require an honorary research contract
Version 1

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Appendix 3: Participant Information Sheet (Chapter 4, Paper Two)

'Physical Activity Services for Adults with Type 2 Diabetes'

Information Sheet (Interview Phase)

We would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Talk to others about the study if you wish. Ask us if there is anything that is not clear or if you would like more information.

Who is conducting the research?

The research is being carried out by Dr Lynsay Matthews from the Physical Activity for Health Research Group, based at the University of Strathclyde. The study forms part of Lynsay's PhD project, supervised by Professor Nanette Mutrie and Dr Alison Kirk, which looks at physical activity services provided for adults with type 2 diabetes.

What is the purpose of the study?

This phase of the study aims to find out the views and opinions of various people on the topic of physical activity and diabetes. It is hoped by finding out this information from the key people at the centre of diabetes (i.e. patients themselves and also different members of NHS staff), we will be able to work on developing new services within the NHS for patient care in diabetes.

Why have I been invited?

You have been invited to take part in this study as a key person involved in diabetes care (either as a patient or member of staff). We hope to find out the views and opinions of various people and your individual response will provide an important insight.

Do I have to take part?

It is up to you to decide if you are willing to participate. We will give you an information sheet to read and you will have the opportunity to ask questions. You will be asked to sign a consent form to show you have agreed to take part. You are free to withdraw at any time, without giving reason. This would not affect the standard of care you receive or your future treatment.

What does taking part involve?

You will be asked to take part in either a one-to-one interview with the researcher (approx 20-30 minutes). This will involve you discussing your honest views and opinions on physical activity and diabetes. The interview will be recorded by a dictaphone. Your name will not be mentioned during the interview, therefore the recording will remain anonymous. It is important for us to find out this information to help develop future services; there are no right or wrong answers.

What happens to the information?

Your identity and personal information will be completely confidential and known only to the researcher. The information obtained will remain confidential and stored within a locked filing cabinet. The University of Strathclyde is registered with the Information Commissioner's Office who implements the Data Protection Act 1998. All personal data on participants will be processed in accordance with the provisions of the Data Protection Act 1998.

What are the possible benefits of taking part?

It is hoped that by taking part in this research, you will be providing valuable information regarding the routine care of adults with diabetes, in particular with a focus on physical activity information. This important information can lead to further developments in patient care for adults with diabetes.

This study has been granted approval by the University of Strathclyde Ethics Committee.

What happens next?

If you would like to take part in the study you will be asked to sign an informed consent form prior to the interview. If you do not wish to take then may I thank for you reading this information. Once the study is complete you will receive a summary of the results, which will also be used in the main researchers PhD thesis.

If you have any further questions?

We will give you a copy of the information sheet and signed consent form to keep. If you would like more information about the study please contact the main researcher; *Dr Lynsay Matthews*, PhD Researcher, Physical Activity for Health Dept, University of Strathclyde, Tel: 0141 950 3441 or email: lynsay.matthews@strath.ac.uk

If you have any questions/concerns, during or after the investigation, or wish to contact an independent person to whom any questions may be directed or further information may be sought from, please contact: Secretary to the University Ethics Committee, Research & Knowledge Exchange Services, University of Strathclyde, Graham Hills Building, 50 George Street, Glasgow, G1 1QE, Telephone: 0141 548 3707, Email: ethics@strath.ac.uk

Thank you for reading this information – please ask any questions if you are unsure about what is written here.

Appendix 4: Participant Information Sheet (Chapter 5, Paper Three)

'Evaluation of NHS Grampian's Pilot Physical Activity Service'

Information Sheet (Interview Phase)

We would like to invite you to take part in an evaluation of the current pilot physical activity service for people with diabetes. Before you decide you need to understand why the evaluation is being done and what it would involve for you. Please take time to read the following information carefully. Ask us if there is anything that is not clear or if you would like more information.

Who is conducting the evaluation?

The evaluation is being carried out by Lynsay Matthews from the Physical Activity for Health Research Group, based at the University of Strathclyde. The evaluation forms part of Lynsay's PhD project, supervised by Professor Nanette Mutrie and Dr Alison Kirk, which looks at physical activity services provided for adults with type 2 diabetes.

What is the purpose of the evaluation?

This phase of the evaluation aims to collect information from various people involved in the pilot physical activity service. In particular, we hope to gain an insight into your experience of the service in relation to 'what has worked well' and 'what challenges you have encountered'. It is hoped this information will highlight key successes and challenges for a future physical activity and diabetes service.

Why have I been invited?

The pilot physical activity service is one of the first implemented in Scotland for people with diabetes. Therefore, your experience is valuable. You have been invited to take part in this study as a one of several people with an insight into the initial stages of the pilot physical activity service. We hope to invite you to participate in another interview later in the year, to provide your ongoing experience of the service.

Do I have to take part?

It is up to you to decide if you are willing to participate. We will give you an information sheet to read and you will have the opportunity to ask questions. You will be asked to sign a consent form to show you have agreed to take part. You are free to withdraw at any time, without giving reason.

What does taking part involve?

You will be asked to take part in a one-to-one interview with Lynsay Matthews (approx 30 minutes), where your experience of the pilot physical activity service will be explored. It is important for us to find out this information to help develop future services; there are no right or wrong answers. The interview will be recorded by a digital dictaphone.

What happens to the information?

The recorded interview will be transcribed and analysed along with other interviews to identify key themes in the initial stages of the pilot physical activity service. You will not be identified from the transcript and your identity will remain confidential. The information obtained will remain confidential and stored within a locked filing cabinet. The University of Strathclyde is registered with the Information Commissioner's Office who implements the Data Protection Act 1998. All personal data on participants will be processed in accordance with the provisions of the Data Protection Act 1998.

What are the possible benefits of taking part?

It is hoped that by taking part in this evaluation, you will be providing valuable information regarding the implementation of a pilot physical activity service for diabetes.

What happens next?

If you would like to take part in the evaluation you will be asked to sign an informed consent form prior to the interview. If you do not wish to take then may I thank for you reading this information.

If you have any further questions?

We will give you a copy of the information sheet and signed consent form to keep. If you would like more information about the evaluation please contact Lynsay Matthews**,** PhD Researcher, Physical Activity for Health Research Group, University of Strathclyde on 07834905383 or by email on lynsay.matthews@strath.ac.uk

Thank you for reading this information – please ask any questions if you are unsure about what is written here.

Appendix 5: Example Consent Form

‘Physical Activity Services for Adults with Type 2 Diabetes’

Consent Form

Please initial the BOX

I confirm that I have read and understand the information sheet dated 15/5/2012 (version 2) for the above study and have had the opportunity to ask questions

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason; I can also withdraw my data from the study at any time without giving a reason.

I understand that any information recorded in the investigation will remain confidential and no information that identifies me will be made publicly available.

I agree to take part in the above study

Name of participant	Date	Signature
Name of researcher	Date	Signature

1 copy to the patient, 1 copy to the researcher, 1 Original for the patients' notes

Appendix 6: Example Interview Transcript

Participant: Health Board Policy Manager

Introductions made prior to Dictaphone being switched on …

Researcher: Just to start could you maybe just give me an idea of what your role is?

Participant: My job title is Health Improvement Senior for Physical Activity. So I am the lead for the physical activity within Glasgow and Clyde health board. So that covers six local authorities, with 1.2 million people. But there's myself and a colleague, FW, who is on mat [maternity] leave at the minute. It's myself and FW that have got the physical activity remit. There's only two of us within the area that have the physical activity remit so it's quite challenging in that sense. So essentially, our main aim is to increase the physical activity levels within the board; so that goes from cradle to grave. From early years right the way through to older adults, we're trying to increase the physical activity levels. Predominantly my work sits around with kind of key stakeholders and partner organisations at a strategic level. So working with the local authorities, maybe with their leisure trusts, to help manage some of their programmes. So we fund some of the things over to Glasgow Life for example in the form of exercise referrals schemes, community rehabilitation programmes, walking programmes, these kind of things. As well as that we also work with our own XX and planning, environmental aspects, the walkability of the environment, education, what we do within our schools. So working at a strategic level to put things in place, trying to influence what they do to make sure that physical activity is on their [schools] Curriculum for Excellence. Within the primary care aspects of course our main product is the *Live Active*, which is our GP exercise referral scheme for people who want to increase their physical activity levels. So that pretty much sits within that. We also have a role within the Chronic Disease Management Programme. We have a local enhanced service, for which there is one for diabetes, heart disease, stroke and respiratory. I think there's also one coming out for learning disability and heart failure. So we have a number of these condition specific [programmes]. And what would happen is if people are called in for an annual review and taken through blood pressure checks, cholesterol checks, and as part of that there are lifestyle questions of which we kind of get to physical activity on there. Again we need to put the case forward to make sure that physical activity is on that. So we are the ones that would design the question to decide what information goes on the template on the computer screen that the practice nurse or GP would use when someone with diabetes or heart disease comes in for that annual review. We get them to ask the physical activity question. As well as that there's any form of communication we can provide to primary care to make them aware of the services that are available. That in itself has its challenges (laughs). That's primarily my role.

Researcher: That's a lot.

Participant: [laughs] Yeah, it is a lot. Especially with only two of us. The way that our team works is we sit within Public Health. So we have a board-wide remit and as I say it's very much a topic focus. You will have health improvement teams within the localities. So within the CHCP's [Community Health Care Partnerships]. So there will be health improvement teams within Glasgow; in the northwest , northeast and south. There will be different health improvement teams within East Dumbartonshire, West, Dumbartonshire, Renfrewshire, East Renfrewshire, Inverclyde. So they will all have their own health improvement teams. Our teams [Glasgow and Clyde] will be slightly different because they all have a topic focus. If you went to East Renfrewshire they wouldn't have a topic focus. They wouldn't have someone with a remit for physical activity. What they would have, say, is a remit for Older Adults, or Early Years - it's more broken down that way. But what we've tried to do is, well from my point of view, is get physical activity on their agenda. So in a sense, they will have a portfolio, so I've tried to get physical activity in there. So if I, from a strategic level, as a board priority, and I say I need something about physical activity in there then it's the only way that it'll get done. Because we've now got HEAT targets. And PA isn't a HEAT target. So if you've got a target that's going to measured by the government then all the focus will go on that. So that's what the local health improvement teams will do they'll do; they'll focus on the HEAT targets, the big things they are going to be judged against. Because physical activity isn't on that it's very difficult to try and shout up from down the bottom and get anything done. We do try and get it in planning frameworks so that there is a responsibility for the areas to do something about physical activity. But it's patchy [across the health boards]. Some people are quite good, some people are not so good.

Researcher: This has actually been interesting already because it's the first time I've heard how it all works. Obviously when your researching big bits come up, but there's all these little ….

Participant: Yeah, it is difficult. In Glasgow, for example, we have a Glasgow physical activity strategy. That's the only area within the board, within Scotland, that has a physical activity strategy. So lots of things happen in Glasgow that wouldn't then happen elsewhere. Inverclyde has just pulled together, has just finalised its physical activity strategy but again it's patchy how things are happening. Where locally they prioritise the HEAT aspect, [HEAT] has added a complexity on top of that.

Researcher: Why do you think, if the evidence is there to show that PA has the effect, it's way way up there at the top of the WHO agenda, why do you think it's not a HEAT target?

Participant: I think the reason is it's not a HEAT target, well I'm just guessing here, is because of the difficult of measuring PA. With the HEAT targets we've got at the minute around say smoking cessation, [or] childhood obesity, those are things that you can measure. You can get BMI, height to weigh ratios, does someone smoke, yes or no, you can carbon monoxide monitor that, if it's the number of people coming to groups. There's a kind of measurability to that. Whereas from a physical activity point of view it's all self-reported; how accurate is that information that we're getting? I think that is one of the challenges around the HEAT targets, what and how do we measure from a monitoring point of view for a HEAT target. I think that's one of the aspects. I think we've not really followed through on the evidence. Yes the evidence is there and I think the Olympics has profiled it a lot higher, but I don't think we've really got the profile. Even from government level, they will talk about it, but they don't' follow through with that they say. So to give you an example, within this, even within my team, we have two people for physical activity and about 7 or 8 for tobacco. So we've got tobacco for older adults, for acute services, for children and young people, we've got people with a specific remit in each of these areas. Then there's myself and a colleague that have got a physical activity remit. So you can even see within the health board where the priority lies. Our physical activity budget, we get within the health board, is about 3/4million [GBP], so we put about GBP750,000 into the physical activity, the core budget. There might be wee off shoots that we can top up. So that's less than a pound per person spending on physical activity within the [health] board. And we know that the benefits that that's going to bring and how cost effective physical activity can be. So that gives you an idea of 'yeah we talk about physical activity' and how to promote it; we've got the Commonwealth Games, but people aren't following it through with the action. So we've got the Lancet saying 'oh the physical activity from physical inactivity is the same as smoking now, because of the prevalence we're not for PA compared with smoking'. Al l the evidence is there but we're actually just not getting it. It's not a sexy topic in the sense that it's not really high profile. Although we've got the games and [people are saying the right things, if you look at it in terms of alcohol, mental health, tobacco, and even obesity now, physical activity is still sitting way down on the list. So I think if you could even hear the First Minister, or the Chief Medical Officer, they all say we're right behind physical activity, but actually "are you really"? You're saying that in public, but you're not following through with any real funding or really prioritising it. I mean, we've … oh it's frustrating at this end. We've got 'Let's Make Scotland More Active' and following that we've now got a kind of national cycling action plan and we're now developing a walking strategy. Why do we need a walking strategy? We've got a perfectly good physical activity strategy that references walking. Let's stop just making up strategies and just do some of the work that is in it. We know what we've got to do, We just don't seem to be doing any action to get into it. It's frustrating in a way. I feel that on a national level as well we really need to get our house in order and really kind of start backing the stuff that we're saying. Because locally there isn't a lot we can do, in a sense that, well if you think that the budget for this health board is GBP2.8 per year and we've got GBP750,000 to spend, it's peanuts in the scheme of things. So we're limited in what we do. The majority of that funding will go to our Live Active scheme, for the salaries of our advisors. And that doesn't even cover the salaries. It probably pays about ¾ of the salaries and the rest of the money comes from the local authorities because the scheme generates income. People come in and use their leisure facilities who ordinarily wouldn't use them. So we can look and say that's identified as generated income and they are happy to reinvest that money. So we're not even paying for the full scheme. So I think locally we can only manage so much, but so many things are agreed nationally. [such as] Active Schools. Priorities are set nationally, the funding from government to Sport Scotland. So from a health aspect who is influencing the agenda at that national level? There's very little I can do locally because it's set well above my pay scale, [at] national level. What happens within education is we can do so much locally but the priorities are set at national level, so I think this is where we really need to get more influence, at that kind of government level and get them thinking about what we're actually doing and what we need to prioritise. We've got a minister for the Commonwealth Games and Sport, but not for physical activity. So it's just the wee things like that, that are we actually on board with this? So what's going to happen after the Commonwealth Games, will there be a minister at all? So it's things like that, that you're just thinking 'you're saying things but you're not really following through with the actions'. So there you go, that's my rant! [laughs].

Researcher: That's why I'm interested in Type 2 diabetes because I feel the evidence has been there for such a long time, decades, but it's still not an integral part of routine care. And when I've been doing interviews with people in diabetes clinics or primary care, they are saying they know it's [physical activity promotion] important but in the back of their head they are always hoping that someone else has talked about it.

Participant: Oh 'it's not my job'. I've heard that one before.

Researcher: It comes across as, well whose responsibility is it? Should it be someone in particular.

Participant: It's their responsibility. It's everyone's responsibility Lynsay!

Researcher: That's some of the stuff that's coming out [of the interviews]. Well do you feel 'do you think you need training'? Is it because you don't know what to say and how to say it?

Participant: Well we can have a wee discussion. You can have a different perspective on what training they have had.

Researcher: You mentioned that one of your roles was funding projects. How, what is the process that people of through to get something funded?

Participant: There isn't really a process, per se. Most of the money is already accounted for. So although there's about GBP750,000, that's already there, that's already accounted for. There's probably about GBP10,000 to do any ad hoc work. And that gets less and less each year. What you've got is you've got the Live Active scheme and the other core scheme that's funded is Vitality – which is our community based rehab programme, it's therapeutic exercise. So that then funds part of that. The majority of that money is kind of seed funding in the sense that it is sustainable. We don't go down the line of providing free exercise sessions. So we will support the local authority so that they don't run at a loss in delivering these exercise classes on our behalf so that's where all the funding comes. So if there was pots of money sitting over, and there's always money, you could find it essentially. So there is money sitting within the physical activity budget, now that will go on ... that will sit with myself and I will prioritise that to be perfectly honest. So for example, we've really tried to focus on older adults. So we've paid for a new kind of physical activity dvd; a chair based exercise dvd and the production that's went into that. Otago training. So we've really had a training on older adults. And that's kind of where the money has went. The process, what I need to do, is that for each of my objectives, what I need to do is project management plans for each aspect of it. So what are the kind of milestones, where do I want to be, everything is monitored these days. I've got all these performance monitoring targets and with that I need to put in the budget. So that begins even before April; I've already set aside where that GBP10-11,000 is going to go, so anything that comes in after that [the] chances is there's nothing there. Now if I've only spent GBP9,000 in each of my project management plans then the boss will just say excellent and that will go into savings. So everything we get every year has to be accounted for. Where is that money? If you haven't accounted for it then it will just get put in a big pot and classed as savings. So it's quite difficult that way. But there are other pots of money out there in each of the CHCP's, so we could say they might be doing stuff. The challenge for me is that I need to make sure they are doing it based on evidence based stuff. Because there will be things where have people have made comments in the past, saying "yeah we funded that", "yeah don't' really know what it is"; they've just given [money]. It doesn't really happen now; this was when we had money. So they would be funding things, and you'd be like, "why are you funding that?", that's just a waste of GBP30,000." So what kind of monitoring are you getting? Are you getting numbers back?" … "No, we're not getting anything back". So you're just like 'ok!'. So from a physical activity point of view we've brought a group together to look at the whole [area], because as I said we have the Glasgow strategy, but we did have strategies elsewhere. So we brought members of each of the CHCP's [together] as part of one group. So we've now got NHS GGC Health Improvement Physical Activity group. So we've got each area, we focus on different themes … older adults, teenage girls, primary care. At the last meeting we went through the data you've seen [Chronic Disease Management Review report]. So we produce actions and a lot of the actions from the last meetings ware about just getting the information out there. Because the information is really quite powerful to try and take it to some of the forums at primary care. So there's Performance Executive meetings where the clinical director and all these GP reps sit. So we put things like that on the agenda to let GPs see "here's what you're doing"! Because they won't know; their doing it [consultations] on an individual basis. But when it's collated like that [CDRM report] the information is shocking… "Have you seen this?!". And they might sit back and see, "oh, yeah, that isn't very good!" But they're just going through it systematically [with] every patient that's going in.

Researcher: Is the, you know how you said they have a computer screen for the review, is the lifestyle section is that a new thing?

Participant: It's not a new thing. I'm trying to think how old it is. Certainly we've been more involved in it in say the last 5 years but I think it maybe started about 12-

15 years ago. From the GRASP project, which was a heart disease project so I'm trying to think ... was it '97 [1997] or something it said in there [the CMR report]. So our team has taken more control over it since Keep Well came on board in 2006-2007. And that's why I came into post so I don't really know what happened before that. But certainly we've been given more autonomy into the physical activity question and the stage of change questions and the information that goes alongside it. So to make sure the questions are appropriate and use a validated question. What information do we need? So make sure they can click on it and get access to referral forms, inclusion and exclusion criteria for live active and these kind of things. I don't know what happened before that but what we've essentially tried to do is make all the templates the same, which can be difficult because from a physical activity point of view there are contraindications to physical activity. So from a diabetes point of view, that's not as big an issue, but if we think about the heart failure template then the information needed to go in that template is slightly different from that of the diabetes template because depending on the grading of heart failure there is a higher risk of complications if people start exercising. So we've tried to keep them as consistent as possible because it's the same practitioners that will be using the same screens so if they kind of have one patient comes in and they have diabetes so they're on the diabetes screen, then the next patient comes in and there a heart failure patient and it's different information and they are confused. So we've tried to keep the screens as consistent as possible. So it's the same questions that we're asking in each of them. But it might be that there is slightly different information and text for say heart failure. We might be saying they need to go through an exercise tolerance test to refer them on to a service to say there suitable to exercise. Or they can only be at grade 1 and 2, the New York Heart Failure …. I can't remember the scale. So again, there might be specific information on it but we tried to keep it as consistent as possible without safety issues.

Researcher: So if someone [a patient] says they are interested in changing their behaviour they [the clinician] can click on a referral form and then do they need to fill out the referral form in order for the person to go to Live Active or can they just give the person the information [to self-refer]?

Participant: It depends. The way it works is they have …… [laughs] you'll be here longer than half an hour …. You've got all the information on the screens. Have you seen the templates?

Researcher: No.

Participant: I'll send you them.

Researcher: Thank you.

Participant: What we've done is the health behaviour change sits separately. It used to so that it is consistent. So the idea is once they've done their diabetes specific or heart disease specific information - (so they'll go through all the clinical data, take their weight, their height, their cholesterol, blood pressure, they'll go through all that kind of thing) – then they will jump to the health related behaviour change section. Now the way that they are paid, there's certain business rules apply. So for example, they will get an incentive around the QOF. So this is your smoking question. So there are additional payments to this. They get paid on the percentage of completion so I said this to X [colleague] yesterday that I'll try and get the business rules to you because I'm just going by memory here. It's something like they need to complete 90% of the information within it to get the full payment. Okay, if they do 80% they get slightly less [money], 90% of the money and so on and so on. Obviously it's in the practices interest to complete as much of the information as possible. So the way they go through it is a very systematic and it's probably not ideal. So what they'll do is when they get to the health related behaviour change. [The GP asks] do you smoke? [Options]Yes, no. [Patient Answer] Yes? [GP response] Okay, would you be interested in … dah dah dah [followed by the] stage of change question. [GP asks] Are in you interested in stopping smoking? [GP response] Oh you are? Would you like a referral into smoking cessation … dah dah dah here's the information. Then go onto weight management. [GP says] Your BMI is high, would you be interested in looking at your weight, changing it? [Patient response] Yes …. Dah dah dah. Diet is next. Okay and you go through the same thing for each of the topics. So potentially that individual is walking out with five referrals. "I'm stopping smoking, I'm losing weight, I'm stopping drinking, I'm increasing my activity". So it's how we manage that and that's where we deliver training around behaviour change and prioritising a single behaviour and these kind of things. But the physical activity its within that. We know from the data that you've seen I think it's maybe around 50% are only asked the physical activity question. So it might be that they [GPs] are just saying "I've got 10% that I don't need to complete". So from a practice point of view they are using the 10% majority on the physical activity question. So to me that says well clearly physical activity isn't a priority within this. Whether or not it's a priority for the practitioner or the patient, my hunch would be it's not a priority for the practitioner. They are missing out that whole section. So there's an issue around that. Why do I think that is? I think that they have just not joined the dots and I think that's how we … as part of the training. Everyone who takes part and delivers these consultations needs to come on training. So they get payment, that's part of their contract to get paid. Now the GPs don't come along, we only get practice nurses or health care support workers. The way they used to work was that each disease had its own training day. So you'd go along for diabetes and you'd go along for heart disease etc. But what would happen would be it would be the same people that would go to them all. And then we would come in and it would e like a conveyor belt afternoon. So I'd get up and I'd have my ten minutes of physical activity then I'd sit down. Then next up alcohol and they'd sit down. Then next up weight management or nutrition or healthy eating and they'd sit down. So you only had ten minutes to sell it. But the way it was done it was very much just the generic physical activity spiel. Here are the recommendations around physical activity; here are the benefits, the same jargon that's been regurgitated, that we do all the time. But because it was same audience we were changing like two slides as the folk delivery the stroke training. So the same people were sitting there thinking 'we've seen the same slides two weeks ago this presentation', apart from the two slides that are disease specific. So what we did was we then took out the health improvement stuff and delivered it on a separate day and they had to come to that. And that was the topic specific bit so instead of doing it per disease, we did it per topic and that was done separately. Clearly there are issues in the way that that's done because obviously I'm not very good at selling my topic because they are not prioritising it [based on CDMR results]. I think one of the issues is that we're not joining the dots. We're not being clinical enough for the audience. We say like '150 minutes per week of moderate physical activity, the benefits are it will reduce your risk of cancer, stroke, control your weight, mental health and wellbeing, the usual things'. For that particular audience I think what we need to do is make it a lot more specific to their patient, so for diabetes here is how specifically physical activity is going to benefit your patient. I think that's the level that we need to go to. Heart disease, here is specifically how this is going to support your patient and that's where you bring in a lot of the evidence . And I think cause we've just skimmed the surface a bit and just given the generic physical activity spiel that we always do that they are not internalising it in a way. It's just physical activity is good for you, they know that. They know physical activity is good for you but what we're not saying is they'll be a pharmacist or a drug company will come along and they'll say here's a new drug for diabetes patients. They will tell you about the generics and how it's going to do this to insulin levels and things like that and they [clinicians] are sitting there going like "oh yeah" [nods head].

Researcher: I've been to standard talks and amazing talks and even though I'm researching it all the time when I come away from an amazing talk your jaw drops. You're all motivated and inspired and you think if only your patients could hear that one rather than the standard one [the talk].

Participant: Yeah, so I think there's an issue with how we deliver the training. It's difficult with the capacity. Is there another way to do it? What we're looking to do is …. The whole training within the team is changing. We're coming away from doing topic specific training to doing more generic training. In a sense because what we're finding is we all do health behaviour change and motivational interview training in all our training. So you as a practitioner are going 'oh here we go again' because we are delivering the same training to you … raising the issue of physical activity, raising the issue of smoking, raising the issue of child healthy weight. 90% of it is the same. The core part of it, the transferrable skills, are the same. So we're now doing it on a modular basis. So behaviour change is the core, the practical skills and the communication skills. Then we've got the topic bolt on which we're hoping to do online. At the minute that topic bolt on is very generic but in future we could then do disease specific; so physical activity and heart disease, physical activity and diabetes. And actually make it really specific to the practice nurses who can go online in their own protected learning time and find out more about it. And I think that's maybe more the way to go because I think at the minute we're just not joining the dots for them and they are just walking away going 'physical activity is good for you'. But they knew that before they went in. They're not relating it to diabetes.

Researcher: It's mainly practice nurses that come on the behaviour change training?

Participant: We open it out. We've done it differently. We've now got open access training so we've got physios [physiotherapists], speech and language [therapists], OT's [occupational therapists], practice nurses, health care support workers. We've got loads of people coming along. We've also done specific training for practice nurses. So we've all had the training. The difficulty is before you start there's attitude issues, because they'll sit there and they'll tell you "we know all this!". You're teaching your granny to suck eggs.

Researcher: So it's a tick box exercise?

Participant: They've just to sit there … they are disengaged before you've even started the session. Now we have done some research on it through Glasgow Uni [University of Glasgow], where we've videoed consultations with practice nurses and I'll send you this. We were actually showing, using the BEKI score, which was scoring their motivational interviewing techniques, and they've actually come out quite poorly. The practice nurses are telling us on one hand 'they know all this, they do it everyday'; we've actually researched it and we've found well 'you may think you're doing it very well'. So how we deal with that situation, where you've got a really strong group of professionals, really strong minded, and we get a sense of speaking to them and saying "you're saying your knowing [how to do this] but actually you haven't done that consultation as effectively as you could be".

Researcher: And do you think patients still view their GP as a good person to get that information from ?

Participant: Interestingly, the patients that come out of it [videoed consultations] were also asked as part of the research and they thought it was 5 out of 5. So they're obviously coming out of it feeling that it was effective. But when actually it was measured using a scoring technique it wasn't what it could have been. So I definitely think there's a bit of if your GP [gives the information] … it's that credibility factor isn't it? A medical professional; if they're saying it's important for you to do such and such then can have a massive impact on that individual. So if you can get it with a change of ethos within primary care that physical activity is important and they pass that message onto their patients then we'll see a change in the number of referrals through.

Researcher: But less GPs go through the behaviour change training?

Participant: No GPs go through basically.

Researcher: Through choice?

Participant: Through choice. To be fair though very few GPs will actually deliver the local plan service. It will be practice nurses. But I mean there's evidence … from Health Scotland [they] did it a few years back now … that ¾ of GPs didn't know the physical activity recommendations. So at that basic level, that's what we are up against. I mean, it's a pathway as well. So we talk to them about, you mentioned there how they refer to services and things. The way it works is we try to get them [GPs and practice nurses]to refer them through to Live Active as the number one choice. Because they [Live Active]are a behaviour change service around physical activity. They have the time and the capacity to sit down and actually have that detailed conversation with people that they won't get within practice. So what we're essentially saying to GPs and practice nurses is 'identify people who need to increase their physical activity and want to increase their physical activity and then refer on'. We're kind of saying that's your job done. Refer on now to the service who will go on and say, "why haven't you been active? What are the barriers you face?" How can we explore how we can get round some of these barriers? "How much activity you do? How much would you like to do?" Have that kind of discussion and set goals, do some goal planning and things. So that's why I'm saying 'identify them and refer them on'. If people are motivated, then yeah there are other services you can refer into. Just send to the walking, they are already motivated to get active. Just send them to the local leisure centre because they don't need that support. But if they do [need support] refer them to Live Active. So again, what information does the practice have on exercise classes in the local community, the options for physical activity to refer people onto. So they need to have that information in order to signpost people to the activities. Again we are saying Live Active. At the minute Live Active is a referral form that has to be completed by hand. GPs will tell you 'that's a pain in the backside!' That's a reason why they don't refer. We're spending about GBP30,000 to get it on SCI gateway, which will be an electronic referral. Hopefully in the next 6-months. Which we hope will make it easier for the referral process to happen. So hopefully that will have an impact. One of the things within the data is even when people are asked the question 70% of them aren't meeting the recommended levels of physical activity and about the same again [70%] are actually wanting to do something about it. And yet, only something like 2% were referred. So, okay, why is that? We don't really know.

Researcher: The report can't pick up on anything that was talked about in a consultation [GP consultation without referral] but you'd assume that 98%, the remaining 98% weren't receiving any [additional information or support] …

Participant: Yeah, there is very little obviously happening. Now why is that? is it because of the difficulty in referring on? Is it the lack of information on referring on? I mean a lot of the practice nurse know of Live Active; they might not actually know the detail of what it is. So again, that communication between the services and the practice. So I think there are a few things [issues] for people referring. [1] It's the ease with which it is to refer? [2]Is it going to benefit my patient? [3] Do they have a confidence in the service they referring on to? [4] What do they know about the service? So for instance through Live Active we get people come through saying, "My doctor said it was free". Well no, if you want to speak to the advisor, that's free. If you want to use the leisure facilities you get them at a discount but it's not free. Obviously [there are] problems with the information because it's got to be a primary care service. Because they are telling it to people that it's free. It's not free. There is obviously a misunderstanding of what the service is. I've sat in on these consultations. They refer people who are overweight; they don't' necessarily refer people because they are inactive. Because someone isn't overweight they are not focussing on it as a health risk as such. They are not seeing that well 'you've got a normal BMI range, you're pretty much healthy for looking at you, you're completely inactive', but that doesn't seem to be an issue to raise a referral. When actually in having sat in the consultations I'm sitting there going "this person just mentioned to you that they liked doing swimming and you've totally went by it and now you're talking about alcohol." And I'm sitting there going …

Researcher: It can be a preventative measure rather than waiting until they do have [a health problem].

Participant: Exactly. So someone has just said they 'are not active and they'd like to be active' but yet because they are maybe in a normal BMI range they are not being referred through. Most of the people that are referred to Live Active, about 60 odd percent of them are either overweight or obese. So clearly there's a bit about whether 'is this a weight management service?'. So again that communication, that understanding, of what the service actually is or what it does is key I think and what we maybe need to look at is part of some of the data to refer people on.

Researcher: I think the positive thing is that speaking to people and the Live Active referral service has a very good reputation. I've worked in other areas [health board regions] before and the exercise referral service doesn't have a good reputation. So that's a bigger challenge to get people to go. The Glasgow one has got a ….

Participant: Yeah, from the data you've got, see the Healthy Eating aspect I would expect the referrals to be poor because the services have been poor. Although don't quote me on that. That's the reality. There has been very little health eating interventions out there and the weight management stuff has been very patchy where we've got some in some areas, they've started, they've stopped, so I'd expect the referrals to be low because as a practitioner you're going "I don't know if this service exists, they keep stopping and starting it". The confidence that practitioner has in that service is totally gone so I'd expect that from a healthy eating point of view. But Live Active has been around for 13 years and yet we're still getting very few referrals. The challenge is though that that service is running at maximum capacity so although we're saying 'we need to do something about this' the flipside is if we start going to practices and they all start referring then the service is just going to collapse. Because roughly about 96% of the appointments each year are booked so there isn't much scope to do much more with it. So obviously then additional funding and that raises a whole can of worms. The other thing is, if we start going to practices and say "[the referral rate is] 2%, this is ridiculous", and they all go "Right, let's do it!" and they all start referring people for physical activity then well we then the waiting list is going to be 20-weeks. That's going to have a massive impact. So obviously we then need to get the services up to scratch to be able to kind of really increase the confidence of the practitioner. So the SCI gateway stuff, the electronic referral, will have an impact and make it easier for people to refer. The communication about what the service is about, what it does so that there's then a confidence within the practitioner selling it to people. So if you believe in something, and again I think this is for physical activity and if they think yeah this is really important, selling it. If you can get the clinical directors and local champions, that have a credibility, like a peer …. So instead of me from Health Improvement saying 'you should be referring', but if tis Dr Such and Such the clinical director in that area, who they kind of respect, you know at that level there's a kind of credibility that says 'yeah we need to do something about this, we need to raise the profile of physical activity, it's really important'. I think that credibility of someone they recognise kind of comes with it as well. I think it will take time to really get the profile whereas I think at the minute smoking has been so high profile for so many years that the practitioner priorities the smoking. Because that's the biggie, smoking is the big one. If people smoke we need to get them to stop; they might be inactive and overweight, but smoking is the main one. That's the focus and obviously the government has incentivised that to really back up that message that this is the really biggie that you need to focus on. I think we need a more holistic approach, got to be patient centred. If our patients are saying 'yeah I maybe smoke but I want to increase my physical activity' then that's what we should do. And again that's what we're trying to get our training to really focus on. It's that the individuals decision, if they want to increase their physical activity, follow their agenda, not your own agenda. "No but smoking's the big one. That's what we really need to get you to stop". [They] Don't worry about the fact they are inactive, we really need to get you to stop smoking. So I think there's a bit around that and how we train practitioners and I think the difficulty is that because we have incentivised certain bits of this local enhanced service, it then means the same as we talked about the HEAT targets, as soon as you bring in targets or select certain bits to focus on the other bits loose out. And I think that's what we've done within parts of this, we've highlighted certain bits that are really important, but never mind whatever the GP or practice nurses have already kind of … their own beliefs, we've kind of reinforced it a bit, and I think if we were to remove the incentive, the payment incentive, around smoking, it might have an impact around other areas. It might have a level playing field in a sense. I think that's where I don't necessarily believe that I want them to incentivise physical activity. My remit is physical activity but you be speaking to someone whose remit is alcohol, and they'll be sitting there going 'but we need to incentivise alcohol'. Everyone is just silo-thinking and fighting their own wee corner and I don't think that's not to the benefit of the patients. I think that's why we need to try and get more holistic point of view and say well 'there's a number of behaviours here that we need to look at, what is it you would like to address?' And if we can get that from a physical activity point of view I think it would actually increase the numbers of patients coming through but I think it would also improve the motivation and the appropriateness of the patients coming through. Because it's just not a case of 'right you're inactive, here's a referral' because that individual might not be ready to increase their physical activity or it might be that 'you've just given me smoking cessation, I'm going to the smoking cessation as well. It's a bit much to increase my physical activity and stop smoking at the same time.' So I think there's ways in which we deliver the consultation, the template itself, the design of it isn't good. I think that's, everyone agrees on that. How can we improve it? The fact that we ask and collect so much data actually impacts on the consultation. It should be a conversation between the practice nurse or the GP and that individual, whereas we've got the practice nurse actually looking at the screen for the whole time that they're in it because they have to click so much data. So I think there's all these kind of things that we tell them to do things within the training then we're giving them tools which actually contradict what we've just told them to do. So we've said it's all about patient centred, it's all about what they want, and then we give them a template that goes topic by topic. And they need to complete it. 'We're now going to talk about your alcohol, we're now going to talk about your physical activity, your healthy eating, your weight'. So I think we need to think about some of the tools that we're giving primary care and make it actually easier for them to do the job and support that with the training. So, there's' masses to do within it and it obviously isn't' working at the minute. How do we do it? I think it will take time. It's a cultural, a mind-set around physical activity and I think we're now only very much at the beginning of that profile. I think we really need to try and maintain it even after Commonwealth Games

Researcher: And clones and clones of you and your colleagues.

Participant: Yeah, we need more of us, more funding, more everything to get things done. But I think it's kind of difficult again from a kind of diabetes, thinking about services, do we need diabetes specific services? I don't know. I honestly don't know. What do we need to differently for a diabetes patient than anyone else? I think for that individual if we say 'we're sending them to Live Active' I think as long as that Live Active advisor has the training around the different conditions, Parkinson's, MS [multiple sclerosis], diabetes, heart disease. If they're trained to that level within those special populations then that can be a service that anyone can be referred to. I don't think we then need to create something that isn't sustainable for individual groups. That's why our Vitality scheme, we've changed it because we couldn't' provide a class for every condition. I mean we had back pain, COPD [chronic obstructive pulmonary disease], heart disease, falls [falls prevention], osteoporosis.

Researcher: Some people will fall into more than one category.

Participant: Exactly. So what you had is, if we had a heart disease class, you went along, we had a 40-year old and an 88-year old in the same class; totally different needs but with the same condition. As you say you maybe someday… this person has got ….. What class do we send them to? So we've changed it so that it's now based on functional capacity. So it doesn't matter your condition, it's all based on your functional ability and I think that's where we need to get to a much more sustainable model rather than have these [individual classes]… 'you've had a heart attack right that's the class for you' … 'you've had osteoporosis right that's the class for you' … 'you've got diabetes right that's the class for you'. I think actually we need to make our services more accessible for all these different people as opposed to trying to fund the specifics. So the training that the staff have had, so if someone comes in with a learning disability, doesn’t speak English, has diabetes, all these other kind of access issues the service is geared up to cope with it.

Researcher: I feel as though you’ve got several more hours chat in you but you’d better go for your next 10 o’clock meeting.

Participant: It’s in here anyway so … yes I think I had X [colleague] in here yesterday and I talked the ear off her.

Researcher: This has been the best interview yet. Thanks for that.