Improving initiation and maintenance of exercise among people with a chronic disease

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Abstract

One in two Australians has a chronic disease, and a quarter has two or more. Despite the widely documented benefits of exercise for the prevention and management of many chronic diseases, the majority of people with a chronic disease remain insufficiently active. The examination of exercise behaviour must be guided by appropriate theoretical frameworks to improve the effectiveness of exercise interventions to support people with a chronic disease to initiate and maintain participation. In this thesis, two studies with complementary methods were used to examine the exercise behaviour change relating to people with Type 2 diabetes mellitus (T2DM) from the perspective of the participant and the practices of exercise practitioners.

Study 1, a qualitative study, examined the perspective of participants with a chronic disease in an exercise efficacy trial. Five participants with Type 2 diabetes mellitus (T2DM) completed a semistructured interview 12 to 18 months following the conclusion of a 12-week exercise intervention. Two participants were male, and three participants were female, with an age range of 43 to 83 years. The length of time since diagnosis ranged from four to 26 years. The Theoretical Domains Framework (TDF) was used to code interviews deductively, and a range of strategies was identified as critical for exercise initiation and maintenance. The most commonly reported themes were: (1) *reinforcement*; (2) *beliefs about consequences;* (3) *behaviour regulation*; (4) *beliefs about capabilities*; (5) *social influences*; (6) *environmental context and resources*; (7) *emotion*; (8) *goals*, and (9) *social/professional role and identity. Behaviour regulation* was related to the maintenance of exercise.

Study 2, a quantitative study, examined the use of behaviour change techniques (BCTs) by 54 exercise practitioners when working with clients with a chronic disease. Exercise practitioners were mostly female (72.2%) and aged between 25 and 34 years

(55.6%). Most of the sample were Accredited Exercise Physiologists (81.5%) and held a postgraduate qualification (65.0%). First, the Behaviour Change Index-Exercise Practitioners (BCI-EP) was developed to measure the use of BCTs in clinical practice. The Index was based on the Coventry, Aberdeen, London-Refined (CALO-RE) taxonomy that describes 40 BCTs relevant to exercise behaviour change. Second, the Index items were grouped according to the dominant TDF domains and administered to examine the use of theory-based BCTs used in practice. BCTs related to the *goals* and *social influences* TDF domains were the most frequently reported groups of techniques used by exercise practitioners. Female gender was positively associated with more frequent use of *environmental context and resources* related techniques compared to male practitioners. Exercise practitioner age was negatively associated with the use of *behaviour regulation* and *beliefs about consequences* techniques. Accredited Exercise Physiologists were less likely to use *reinforcement* BCTs compared to fitness instructors and personal trainers when working with clients with a chronic disease.

This research contributes to the body of knowledge by applying the TDF to understand the initiation and maintenance of exercise among people with T2DM. The results provide insights into the strategies that might influence the uptake and maintenance of exercise among people with T2DM. The study also adds to emerging literature about the importance of *emotion* as a predictor of exercise participation among people with T2DM. *Emotion* related BCTs could be added to taxonomies such as the CALO-RE to expand existing knowledge of exercise participation to improve T2DM management. The newly developed BCI-EP could be applied for a range of research purposes to assess other practitioner's use of BCTs and to examine the relationship between the use of BCTs and exercise uptake and adherence in clinical practice, and exercise practitioner education and training.

A range of cognitive, affective, social, and environmental theoretical domains were related to exercise behaviour change among people with T2DM. These domains theoretical domains must be integrated into the development of exercise interventions to improve the effectiveness of exercise prescription for people with T2DM.

Key words: Exercise, chronic disease, Theoretical Domains Framework, behaviour change techniques, Behaviour Change Index, exercise practitioner, Type 2 diabetes mellitus

Student Declaration

"I, Melissa Anne Sbaraglia, declare that the PhD thesis entitled *Improving initiation and maintenance of exercise among people with a chronic disease* is no more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references and footnotes. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work".

Signature: 

Date: 30 June 2020

Dedication

To my Nonna, Giuseppina Malaspina Cecchini, my Mum Carina Cecchini, and dear friend Katie Alexander – the strongest and most independent women I know.

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List of Abbreviations

ACSM	American College of Sports Medicine
ADA	American Diabetes Association
AEP	Accredited Exercise Physiologist
AIHW	Australian Institute of Health and Welfare
BCI-EP	Behaviour Change Index-Exercise Practitioners
BCT	Behaviour Change Technique
CALO-RE	Coventry, Aberdeen and London-Refined
CVD	Cardiovascular Disease
ESSA	Exercise and Sports Science Australia
HbA1c	Glycosylated Haemoglobin
T2DM	Type 2 Diabetes Mellitus
TDF	Theoretical Domains Framework
WHO	World Health Organisation

Chapter 1: Introduction

This chapter will provide a background on chronic disease and the role of exercise in its prevention and management. The chapter begins with a definition of chronic disease, prevalence rates, and risk factors. Exercise is introduced and defined, and the recommended levels of exercise for health are outlined. The benefits of exercise participation for primary and secondary prevention of chronic disease are explored, and the costs of insufficient exercise are highlighted. Current levels of exercise participation are presented, and the exercise participation rate among people with a chronic disease is discussed. A closer examination of Type 2 diabetes mellitus (T2DM), the leading contributor to chronic disease burden due to insufficient exercise, is provided, and the importance of exercise in its management is discussed. The importance of examining exercise behaviour change of people with a chronic disease is presented. The types of exercise interventions in the literature are described, and, finally, the role of exercise practitioners in the clinical setting for supporting exercise behaviour change among people with a chronic disease is examined.

Chronic Disease

This thesis focuses on T2DM which is one of the most common chronic diseases in Australia. Chronic disease is a broad term referring to a range of chronic and complex health conditions (Australian Institute of Health and Welfare [AIHW], 2019). Chronic diseases are also referred to as ‘chronic conditions’, ‘noncommunicable diseases’, and ‘lifestyle diseases’ in the literature (AIHW, 2019). It has been estimated that half of all Australian adults are living with at least one chronic disease, and almost a quarter have two or more chronic diseases (AIHW, 2019). The most common chronic diseases in Australia are cardiovascular disease (CVD), T2DM, and cancers (AIHW, 2019).

Chronic diseases are the leading cause of death worldwide (Lee et al., 2012) and contribute to 87% of deaths annually in Australia (AIHW, 2019). A combination of modifiable and nonmodifiable risk factors contribute to the development of a chronic disease (Lee et al., 2012). Nonmodifiable risk factors, such as age, gender, race, and family history cannot be modified by an individual (AIHW, 2019). Modifiable risk factors include biomedical and behavioural factors (AIHW, 2019). Biomedical risk factors include hypertension (i.e., high blood pressure), dyslipidaemia (i.e., cholesterol), overweight and obesity, and hyperglycaemia (i.e., high blood glucose levels including T2DM; AIHW, 2019). Behavioural risk factors include tobacco smoking, an unhealthy diet, and insufficient exercise (AIHW, 2019).

Behavioural and biomedical risk factors are the most common risk factors for the development of a chronic disease (AIHW, 2019). The combined effect of modifiable risk factors contributes to 98% of the total disease burden for endocrine disorders such as T2DM (AIHW, 2019). Modifying risk factors for a chronic disease could prevent approximately one-third of the burden of chronic disease in Australia (AIHW, 2019) and, consequently, have become a substantial focus for chronic disease prevention and treatment.

Physical Activity and Exercise

The terms ‘exercise’ and ‘physical activity’ are often used interchangeably; however, the terms are distinct. Physical activity is defined as any bodily movement produced by skeletal muscles resulting in energy expenditure (Caspersen, Powell, & Christenson, 1985). A person may participate in physical activity through their occupation, by performing household chores, or through leisure activities (Caspersen et al., 1985). Leisure-time physical activity refers to recreational activities performed for enjoyment, social, competitive or fitness reasons (Burton & Turrell, 2000). Most Australian adults participate in unstructured physical activity, such as walking, as their preferred leisure-time physical activity (AIHW,

2018b). Leisure-time physical activity confers greater health benefits than incidental physical activity or physical activity performed for transport (e.g., walking to work; Samitz, Egger, & Zwahlen, 2011). Incidental physical activity refers to nonpurposeful physical activity accrued through activities of daily living (Ross & McGuire, 2011). Examples of incidental physical activity include gardening, climbing stairs, and active household chores such as mopping and vacuuming. Some individuals may consider incidental physical activity, such as gardening (or similar), as leisure-time physical activity. Leisure-time physical activity reduces the risk of chronic diseases such as CVD (Nocon et al., 2008; Sofi, Capalbo, Cesari, Abbate, & Gensini, 2008) and mental health conditions (Dunn, Trivedi, & O'Neal, 2001).

Exercise is activity that is planned, structured, repetitive, and has the objective of maintaining or improving physical fitness (Caspersen et al., 1985). Physical fitness refers to a set of health-related or skill-related attributes that people aim to achieve through regular exercise participation. The health-related dimensions of physical fitness include cardiorespiratory fitness, skeletal muscle strength and endurance, body composition, and flexibility (American College of Sports Medicine [ACSM], 2014). Skill-related dimensions refer to specific sports-related skills that increase sports performance, such as speed, reaction time, agility, and power (ACSM, 2014). This thesis is primarily focused on the health-related components of physical fitness that contribute to the prevention and management of chronic disease; therefore, the term ‘exercise’ will be used throughout this thesis. Various types of exercises are performed for health benefits. For example, cardiorespiratory exercise (i.e., aerobic activities such as swimming, cycling, and jogging) and strength exercise (i.e., anaerobic activities such as powerlifting, weightlifting, and bodyweight training; ACSM, 2014).

An exercise prescription refers to a plan typically written by an exercise practitioner for the management of a chronic disease (Moore, 2004). An exercise prescription may vary

depending on the target chronic disease (ACSM, 2014). Much like a pharmacological prescription, an exercise prescription consists of a therapeutic goal, an exercise type, a dose and dosing frequency, and a duration of treatment. Exercise dosage refers to the frequency, intensity, and duration of the prescribed activity (ACSM, 2014). Exercise frequency is usually expressed as the number of sessions performed per day or week (ACSM, 2014). Duration refers to the length of time of each session and intensity refers to the magnitude of effort required during the performance; usually expressed as a percentage of maximum heart rate or subjective rating of perceived exertion (ACSM, 2014). Exercise intensity and duration share an inverse relationship; as one increases the other decreases. Mode refers to the type of exercise, for example, aerobic, strength, or flexibility activities (ACSM, 2014). The volume of exercise refers to the total work performed in a given period (i.e., week or month) and includes the duration of the session and frequency within a training period, and can be expressed as total energy expenditure (ACSM, 2014).

Recommended Levels of Physical Activity

Several leading global and national health authorities recommend regular physical activity participation for the prevention and management of a chronic disease. The World Health Organisation (WHO, 2018) recommends adults aged 18 to 64 years do at least 150 minutes of moderate-intensity physical activity, or at least 75 minutes of vigorous-intensity physical activity per week. An equivalent combination of moderate- and vigorous-intensity physical activity can also be performed across the week (WHO, 2018). For additional health benefits, it is recommended that adults increase moderate-intensity physical activity to 300 minutes per week (WHO, 2018). Muscle-strengthening exercises involving major muscle groups should be performed at least two days per week (WHO, 2018). The same physical activity recommendations apply to older adults aged 65 years and over (WHO, 2018). Additionally, older adults (i.e., 65 years and above) with poor mobility are encouraged to

perform physical activity to improve balance and prevent falls at least three days per week (WHO, 2018).

Australia's Physical Activity & Sedentary Behaviour Guidelines for Adults aged 18 to 64 years recommend adults accumulate 150 to 300 minutes of moderate-intensity physical activity or 75 to 150 minutes of vigorous-intensity physical activity weekly (Australian Government Department of Health, 2020). An equivalent combination of moderate and vigorous physical activity can be performed to achieve the recommendations. Muscle strengthening physical activity should be performed on at least two days per week. Adults who are inactive are encouraged to begin with small amounts of physical activity and gradually build-up to the recommended amount (e.g., 150 minutes of moderate-intensity physical activity weekly). Being physically active on most, preferably all days of the week, and minimising the amount of time spent in prolonged sitting across the day is recommended.

Older Australians aged 65 years and above should accumulate at least 30 minutes of moderate-intensity physical activity on all days of the week (Australian Government Department of Health, 2020). Older adults should perform a range of physical activities to improve cardiorespiratory fitness, muscular strength and endurance, balance, and flexibility. Older adults previously engaging in vigorous-intensity physical activity can continue if safe. Physically inactive older Australians should start at a physical activity level that is practical and slowly progress to the recommended amount (i.e., 30 minutes on most days of the week).

Moderate-intensity physical activity is defined as an activity requiring a reasonable amount of effort that raises the heart rate, such as brisk walking (Norton, Norton, & Sadgrove, 2010). In comparison, vigorous-intensity physical activity requires a higher level of effort to substantially raise the heart rate, for example, running (Norton et al., 2010). Strength training, such as muscle and bone-strengthening physical activities, provide benefits for physical (Churilla, Johnson, Magyari, & Crouter, 2012) and mental health (Westcott,

2012). Greater health benefits are obtained when aerobic and strengthening physical activities are combined, compared to one physical activity mode alone (Mann, Beedie, & Jimenez, 2014).

Benefits of Exercise

Exercise contributes to the primary and secondary prevention of several chronic diseases (Warburton, Nicol, & Bredin, 2006). Primary prevention refers to the role exercise plays in preventing disease from occurring. In contrast, secondary prevention refers to the role exercise has in reducing the impact of established disease, such as the development of CVD in people with diagnosed T2DM. Chronic diseases such as CVD and T2DM share several common behavioural and biomedical risk factors such as tobacco smoking, insufficient exercise, overweight/obesity, and insulin resistance (AIHW, 2017). Insufficient exercise is responsible for 30% of the total disease burden of CVD and T2DM (AIHW, 2019).

Primary prevention. Regular exercise is associated with the reduced risk of premature mortality (i.e., early death) through its effect on cardiorespiratory fitness (Warburton et al., 2006). There is a graded relationship between the volume of exercise and health status whereby higher volumes of exercise are associated with lower risk of premature mortality (Warburton et al., 2006). Adults who report high levels of exercise and cardiorespiratory fitness have a reduced risk of premature death by approximately 20 to 35% (Macera, Hootman, & Sniezek, 2003; Macera & Powell, 2001). Other studies have shown a greater than 50% reduction in risk of premature mortality from any cause and CVD with high levels of cardiorespiratory fitness and exercise (Myers et al., 2004). Exercise and cardiorespiratory fitness have protective benefits in the presence of other risk factors for CVD. For example, observational studies have shown that people who are physically inactive with no additional risk factors fare worse than people who are physically active with other

risk factors of chronic disease (Blair et al., 1996; Katzmarzyk, Church, & Blair, 2004; Wessel et al., 2004).

Regular exercise contributes to the primary prevention of T2DM (Warburton et al., 2006). Aerobic and resistance exercises are associated with a decreased risk of developing T2DM (Biddle & Vergeer, 2019; Helmrich, Ragland, Leung, & Paffenbarger, 1991; Helmrich, Ragland, & Paffenbarger, 1994; Lynch et al., 1996; Manson et al., 1992; Roter, Hall, & Aoki, 2002; Warburton, Glendhill, & Quinney, 2001; Williamson, Vinicor, & Bowman, 2004). In a large prospective study, every increase of 500 kilocalories in energy expenditure per week was associated with a decreased incidence of T2DM by six percent (Helmrich et al., 1991).

Regular exercise participation is protective among people at high risk of developing T2DM even in the presence of other risk factors (e.g., such as those who are overweight/obese; Gregg, Gerzoff, Caspersen, Williamson, & Narayan, 2003; Manson et al., 1992). Lifestyle interventions incorporating exercise have shown to be protective against the development of T2DM among people who are at high risk (Lynch et al., 1996). Lifestyle interventions that include exercise have been shown to reduce the incidence of T2DM among overweight/obese individuals (Laaksonen et al., 2005; Tuomilehto et al., 2001). A review of randomised controlled trials concluded that weight loss through diet and exercise reduced the incidence of T2DM among individuals at high-risk by approximately 40 to 60% over a three to four year period (Williamson et al., 2004). Additionally, lifestyle interventions have shown to be more effective than medication alone in the prevention of T2DM. A lifestyle intervention including moderate-intensity exercise for at least 150 minutes per week was more effective than glucose-lowering medication alone in reducing the incidence of T2DM (Knowler et al., 2002). For example, seven people would need to be treated with the lifestyle

intervention to prevent a single case of T2DM over three years, compared with 14 people for treatment with medication (Knowler et al., 2002).

Secondary prevention. The benefits of exercise and high levels of cardiorespiratory fitness extend to people with established disease such as CVD and T2DM (Taylor et al., 2004; Wannamethee, Shaper, & Walker, 2000). Several systematic reviews have shown that engaging in regular exercise can attenuate or reverse the disease process in patients with CVD. A systematic review and meta-analysis of 48 randomised controlled trials revealed that, compared with usual care, cardiac rehabilitation (which includes exercise) significantly reduced the incidence of premature death from any cause and CVD (Taylor et al., 2004). Exercise is effective in the prevention and treatment of coronary artery disease and atherosclerosis (i.e., plaque accumulation) leading to myocardial infarction. For example, energy expenditure of approximately 1600 kilocalories per week can delay the progression of coronary heart disease. An energy expenditure of approximately 2200 kilocalories per week reduced plaque accumulation in patients with existing CVD (Franklin, Swain, & Shephard, 2003; Hambrecht et al., 1993).

A prospective study evaluating the effect of exercise among people with T2DM showed that walking at least two hours per week was associated with a reduction in the incidence of premature death of 39 to 54% from any cause and of 34 to 53% from CVD among patients with T2DM (Gregg, Gerzoff, Caspersen, Williamson, & Narayan, 2003). Regular exercise is a crucial aspect of standard T2DM treatment (American Diabetes Association [ADA], 2014). Several randomised controlled trials have evaluated the effects of exercise for T2DM management (Agurs-Collins, Kumanyika, Ten Have, & Adams-Campbell, 1997; Daly et al., 2005; Dunstan et al., 2002; Dunstan et al., 2005; Holten et al., 2004). Meta-analysis has shown that exercise training improves glycaemic control in T2DM

(Boule, Haddad, Kenny, Wells, & Sigal, 2001). Improvements in T2DM management are most significant with combined aerobic and resistance training (Sigal et al., 2007).

Disease Burden and Costs of Insufficient Exercise

In addition to discussing the benefits of exercise, it is essential to acknowledge the costs associated with insufficient exercise. Insufficient exercise is defined as an exercise level that does not meet the minimum required to promote health (i.e., 150 to 300 minutes of moderate-intensity exercise per week; AIHW, 2017). Approximately six to 10% of global mortality associated with a chronic disease is due to insufficient exercise (Lee et al., 2012) making it the fourth leading cause of death worldwide (Kohl et al., 2012). Insufficient exercise contributes to 2.5% of total disease burden in Australia and is responsible for 20% of the disease burden for T2DM (AIHW, 2017). In 2013, insufficient exercise cost the international health care system $53.8 billion (Ding et al., 2016). It has been estimated that insufficient exercise costs the Australian healthcare system at least $805 million in total health care costs when direct healthcare expenditure and loss in productivity are considered together (Ding et al., 2016).

Physical Activity Participation Levels

Globally, up to 60% of adults are insufficiently active to achieve health benefits (Hallal et al., 2012). Similarly, it has been estimated that over half (55%) of Australian adults do not meet the weekly minimum level of recommended aerobic exercise (i.e., 30 minutes on most days of the week; AIHW, 2019). Further, results from the National Nutrition and Physical Activity Survey revealed that only 18.6% of Australians met the recommended strength training guidelines (i.e., two sessions per week) and only 15% met the combined aerobic and strength physical activity guidelines (Bennie et al., 2015). Some Australians are less likely to participate in exercise than others, such as women, older adults, those with poor self-rated health, those who are obese, those who experience socioeconomic disadvantage, and people with a chronic disease (Bennie et al., 2015). Socioeconomically disadvantaged

groups experience rates of disease burden due to insufficient exercise 1.7 times greater than socioeconomically advantaged Australians (AIHW, 2017).

People with a chronic disease are less likely to participate in exercise than people without a chronic disease (Durstine, Gordon, Wang, & Luo, 2013). Adults with T2DM report low levels of exercise and are less active than people without T2DM (Kennerly & Kirk, 2018). Several studies have reported adherence to exercise recommendations in people with T2DM to be between 25 and 41.7% (Morrato, Hill, Wyatt, Ghushchyan, & Sullivan, 2007; Resnick, Foster, Bardsley, & Ratner, 2006; Zhao, Ford, Li, & Mokdad, 2008, 2011). People with T2DM and diabetic complications are even less active compared to those with T2DM without comorbidities (Nolan, Raynor, Berry, & May, 2016). Adults with T2DM participate in less exercise than the general population and are less likely to meet exercise guidelines. Therefore, there is a need to improve uptake and maintenance of exercise to provide primary and secondary chronic disease prevention.

A closer examination of exercise participation in T2DM. T2DM is a metabolic disease characterised by hyperglycaemia (i.e., high blood glucose levels). T2DM develops when muscle, fat, and liver cells become resistant to the action of insulin, causing glucose to accumulate in the bloodstream (Alberti, 1996). The pancreas responds to this hyperglycemia by producing more and more insulin, and over time the pancreas fails to keep up (Alberti, 1996). The exact cause of insulin resistance is unclear. However, a combination of nonmodifiable (e.g., age, ethnicity, genetics), biomedical (e.g., dyslipidemia, overweight/obesity) and behavioural factors (e.g., unhealthy diet, insufficient exercise, and tobacco smoking) increases the risk for developing T2DM (Alberti et al., 2009).

Poorly controlled glycemia (i.e., blood glucose levels) may lead to microvascular and macrovascular complications. Microvascular complications refer to diseases in the small blood vessels of the body and include nephropathy (causing kidney failure), neuropathy

(damaging nerves), and retinopathy (causing blindness; ADA, 2014). Neuropathy increases the risk of developing infection and can lead to limb amputation (ADA, 2014). People with T2DM have a 25 times greater risk of amputation than people without T2DM (Apelqvist, Bakker, Van Houtum, & Schaper, 2008) and T2DM is the leading cause of limb amputations in Australia (Tanamas et al., 2013). Macrovascular complications refer to diseases in the large blood vessels of the body and include a variety of CVDs, peripheral arterial disease, and cerebrovascular disease (stroke; ADA, 2014). Reducing hyperglycemia and maintaining healthy blood glucose levels may prevent or delay T2DM complications (ADA, 2014).

The main goal for the management of T2DM is controlling glycemia to prevent or delay macrovascular and microvascular complications (ADA, 2014). Glycosylated haemoglobin (HbA1c) is a measure of the average level of blood glucose over three months (ADA, 2014). A HbA1c threshold of 6.5% and above is used to diagnose T2DM (ADA, 2014). A high HbA1c is associated with greater risk of complications in T2DM (ADA, 2014). Following a diagnosis of T2DM, the most common management options include a healthy diet, regular exercise and, where necessary, weight loss (ADA, 2014). However, as the condition progresses, hyperglycemia becomes increasingly challenging to manage, and pharmacological therapy is usually indicated (ADA, 2014). The treatment progression for T2DM typically includes a biguanide-class medication such as metformin (ADA, 2014). If metformin is insufficient to reduce hyperglycemia to the desired level, then it may be combined with up to two additional drugs (ADA, 2014). Insulin therapy is indicated when a combination of three oral medications fail to reduce blood glucose levels sufficiently (ADA, 2014). Regular exercise is vital at all stages of T2DM, regardless of the administration of combination oral medication or insulin therapy, to delay macrovascular and microvascular complications (ADA, 2019).

To improve glycaemic control and reduce the risk of secondary CVD, the ADA (2019) recommends people with T2DM achieve at least 150 minutes a week of moderate-intensity exercise, or at least 90 minutes per week of vigorous-intensity exercise, on at least three days. Aerobic exercise performed at moderate- to vigorous-intensity improves the responsiveness of skeletal muscles to insulin, thereby reducing insulin resistance (Christ-Roberts et al., 2004; Holten et al., 2004; O'Gorman et al., 2006; Paffenbarger et al., 1993). However, this reduction in insulin resistance lasts for a period of only two to 72 hours (Boule et al., 2001). Therefore, it is recommended that exercise is performed regularly and with no more than two consecutive days without exercise (Colberg et al., 2012).

Improvements in HbA1c are most significant with combined aerobic and resistance training (Sigal et al., 2007). A randomised controlled trial was conducted to assess the impact of aerobic training alone, resistance training alone, and combined exercise training on HbA1c levels in people with T2DM (Sigal et al., 2007). Two hundred and fifty-one adults age 39 to 70 years with T2DM were assigned to aerobic training, resistance training, combined training (aerobic and resistance), or an inactive control group, three times per week for 22 weeks. The primary outcome was the change in HbA1c value at six months. The absolute change in the HbA1c level in the combined training group compared with the control group was -0.51 percentage point (95% CI [-0.87 to -0.14]) in the aerobic training group and -0.38 percentage point (95% CI [-0.72 to -0.22]) in the resistance training group. Combined exercise training resulted in an additional change in the HbA1c value of -0.46 percentage point (95% CI [-0.83 to -0.09]) compared with aerobic training alone and -0.59 percentage point (95% CI [-0.95 to -0.23]) compared with resistance training alone (Sigal et al., 2007).

The reduction in HbA1c achieved with exercise is similar to reductions observed in intensive glucose-lowering therapy (medication) and is associated with a 42% reduction in diabetes-related mortality (Boule et al., 2001). However, most individuals with T2DM do not

participate in exercise levels required to manage their disease effectively (Morrato et al., 2007; Resnick et al., 2006; Zhao et al., 2008, 2011). Therefore, examination of the factors associated with exercise behaviour among people with a chronic disease is needed to improve the effectiveness of exercise behaviour change interventions.

Exercise Practitioners

Exercise practitioners deliver exercise programs to people with a chronic disease in clinical and community settings. Exercise practitioners may also be recruited to deliver exercise interventions in research. Two types of exercise practitioners in the Australian context include fitness professionals (e.g., fitness instructors and personal trainers) and Accredited Exercise Physiologists (AEPs).

Fitness professionals. The increasing knowledge of the health benefits of exercise has led to substantial growth in the fitness industry over the past five years (Australian Industry and Skills Committee, 2020). An estimated 3.6 million Australians participate in fitness and gym activities, the second most popular type of exercise among Australians (second to walking; AIHW, 2018b). Approximately 27,600 fitness professionals are servicing the fitness industry in health clubs, fitness centres, and gyms (Fitness Australia, 2016). The fitness industry was estimated to generate $2.5 billion in revenue between 2018 and 2019 and is expected to grow over the next five years (Australian Industry and Skills Committee, 2020).

The minimum qualification level required to be registered as a fitness professional is a vocational certificate III or IV (Fitness Australia, 2019). Fitness professionals are qualified to plan and deliver exercise interventions for individuals considered a low or moderate risk of chronic disease. However, fitness professionals may work with individuals with a chronic disease (i.e., high-risk) under the guidance of a medical practitioner or an allied health

professional. Fitness Australia oversees the fitness industry and provides certification to individuals to practice. Fitness professionals receive behaviour change education in their courses and there are a range of continuing education courses offered in behaviour change strategies. The scope of practice for the fitness professional includes the provision of evidence-based exercise behaviour change to promote exercise adherence through the use of techniques such as goal setting, social support, and relapse prevention.

Accredited Exercise Physiologists (AEPs). AEPs are allied health professionals holding the highest level of qualification for prescribing exercise in Australia (i.e., minimum of a four-year bachelor's degree; Exercise and Sports Science Australia [ESSA], 2015b). Over 3,540 AEPs practice in Australia in a range of settings, including primary healthcare, hospitals, private practice, and community clinics (Deloitte Access Economics, 2015; ESSA, 2015b). AEPs are also employed in the fitness industry and work alongside fitness professionals where they may oversee exercise interventions delivered by fitness professionals. An AEP's scope of practice includes the provision of screening and assessment, development of individualised exercise prescription, and provision of health education for those with existing chronic and complex conditions (ESSA, 2015b). ESSA is the peak professional organisation and accrediting authority for AEPs (ESSA, 2015b).

Exercise physiologists accredited with ESSA are eligible to apply for a Medicare provider number to deliver subsidised allied health services to people with a Chronic Disease Management Plan (Australian Government Department of Health, 2019). A Chronic Disease Management Plan allows people with a chronic disease to access Medicare rebates for allied health services on referral from their general practitioner (Australian Government Department of Health, 2019). People with a chronic disease can be referred for up to five allied health services each calendar year, where a single allied health provider can provide all services (e.g., AEP) or services can be shared across different providers (e.g., AEP and

dietitian). People with T2DM are eligible for additional allied health services under a Chronic Disease Management Plan to access group allied health services (in addition to the five individual allied health sessions per year; Australian Department of Health, 2019) Group services can be delivered by AEPs, dietitians, and diabetes educators (Australian Government Department of Health, 2019).

In summary, AEPs are university qualified allied health professionals who deliver services within the public health system for people at risk of developing, or with existing chronic and complex medical conditions and injuries. Personal trainers are not required to be university qualified and are largely employed in the fitness and recreation sector to deliver exercise services to people at low risk (i.e., apparently healthy).

Exercise Interventions

There has been increasing research attention on the role of exercise in primary and secondary chronic disease prevention. Randomised controlled trials are considered the gold standard in evaluating healthcare interventions, including exercise interventions (Moher et al., 2012). Randomised controlled trials that evaluate exercise interventions vary in their primary outcomes and methodological frameworks. Depending on the primary outcome of the trial, exercise interventions can be considered efficacy trials or behaviour change trials (Courneya, 2010). Researchers who are primarily focused on the effect of exercise on a health outcome will often adopt an efficacy trial (Courneya, 2010). Other researchers are interested in a change in levels of exercise participation as their primary outcome (Courneya, 2010).

Efficacy trials. The goal of an efficacy trial in chronic disease primary or secondary prevention is to examine the effect of an exercise program on the desired health outcome among a group of individuals, for example, people with T2DM (Courneya, 2010). The

desired health outcome may include cardiorespiratory fitness, body composition, or blood glucose levels (e.g., HbA1c). Efficacy trials usually examine the effect of a highly structured and supervised exercise program under optimal conditions and often recruit participants who are insufficiently active and require them to begin exercise at high volumes (Courneya, 2010). During an efficacy trial, when a participant fails to adhere to the prescribed intervention, it is considered a protocol deviation (Moher et al., 2012). According to the 'intention to treat' principle, participants that fail to adhere to the intervention must still be included in data analysis (Moher et al., 2012). Therefore, efficacy trial research teams will likely use behaviour change strategies to encourage participants to adhere to the prescribed exercise intervention (Courneya, 2010).

Behaviour change trials. Exercise behaviour change trials in primary and secondary chronic disease prevention examine the effectiveness of behavioural change strategies in increasing an aspect of exercise participation (Courneya, 2010). For example, a behaviour change trial may examine the effect of goal setting on promoting the initiation of exercise among people with T2DM who have previously been insufficiently active. Additionally, a behaviour change intervention may seek to examine the effect of behaviour change strategies (e.g., practical support, demonstration of behaviour) on increasing levels of exercise. Therefore, unlike an efficacy trial, participants in a behaviour change trial can be physically active before the trial begins (Courneya, 2010). During a behaviour change trial, when a participant fails to adhere to the intervention, it is also considered a protocol deviation and the participant must still be included in data analysis (Moher et al., 2012).

Therefore, behaviour change strategies are employed during exercise efficacy trials and behaviour change trials, however, their use is different. Efficacy trials may adopt behaviour change strategies informally to facilitate intervention adherence by participants, whereas behaviour change trials examine exercise participation as their primary outcome,

facilitated by the use of behaviour change strategies (Courneya, 2010). Intervention protocols are likely to reflect these differences in the use of behaviour change strategies (Courneya, 2010). For example, behaviour change strategies are generally reported a priori in behaviour change interventions and ad hoc in efficacy trials (Courneya, 2010).

Exercise Behaviour Change

Behaviour change is most effective when interventions are based on principles drawn from theories of behaviour change (Michie, 2008). Behaviour change interventions have traditionally included poor reporting of their intervention content and their underlying theoretical basis (Michie, Abraham, Whittington, McAteer, & Gupta, 2009; Michie, Johnston, Francis, Hardeman, & Eccles, 2008; Michie et al., 2013). Additionally, researchers have found that in cases when interventions are informed by theory, the connection between the theory and the intervention is often weak (Michie et al., 2008). Complex behavioural interventions, such as exercise interventions, suffer from a high degree of heterogeneity in their research design (Michie, 2008). These methodological problems pose several complications in determining effective mechanisms of behaviour change and the influence of context and mode of delivery of interventions (Michie, 2008).

Recent advances in the study of health behaviour change have sought to improve the scientific knowledge of behaviour change (Michie, 2008). Several frameworks and tools have been developed to provide a systematic and theoretical basis for understanding and changing health behaviour. They provide an integrated approach for conceptualising and defining intervention content, and linking mechanisms of behaviour change to their theoretical base (Michie, 2008). Applying these frameworks to study exercise behaviour among people with a chronic disease can inform more effective interventions for management of chronic diseases.

Exercise behaviour change is rarely maintained long-term and recent evidence suggests that strategies that are effective in the initiation of exercise may be different to those which are associated with maintenance of participation (Kwasnicka, Dombrowski, White, & Sniehotta, 2016). Behaviour change interventions may be useful for supporting individuals to achieve temporary behaviour change. However, people with a chronic disease are at an increased risk of drop-out after initiating exercise (Dorn, Naughton, Imamura, & Trevisan, 2001). In a study investigating the effects of combined aerobic and resistance training in people with T2DM, 15% in the exercise groups withdrew before completing the six-month intervention (Sigal et al., 2007). In another exercise intervention, 20% of participants with T2DM had dropped out before 12 months (Simpson et al., 2015). Following participation in a supervised resistance training intervention, participants with T2DM were encouraged to continue exercise in an unsupervised setting after the completion of the trial. Exercise adherence dropped by approximately 15% within six months of completing the six-month intervention, and the volume of exercise had reduced to the point that it was no longer sufficient for the effective management of T2DM (Dunstan et al., 2005).

Efficacy trials (i.e., randomised controlled trials) contribute to much of the evidence for the secondary prevention of chronic disease (Beedie et al., 2016). Participants in efficacy trials are typically highly motivated, homogenous, and do not have additional comorbid conditions (Glasgow, Lichtenstein, & Marcus, 2003). Therefore, these interventions have less generalisability and applicability to real-world settings where the same intervention may not appeal to a broader cross-section of participants, many of whom have comorbid conditions and may not volunteer for treatment (Glasgow et al., 2003). Additionally, highly motivated participants who were successful in the efficacy trial fail to adhere to exercise outside of the research setting (Dunstan et al., 2005; Lunt et al., 2014). A better understanding of exercise behaviour change for people with a chronic disease will lead to more effective strategies to

promote uptake and maintenance of exercise. Such an understanding is essential to inform exercise practitioner training programs.

Summary

There has been a proliferation of clinical and research interest into the effects of exercise and exercise in the prevention and treatment of a chronic disease. However, participation rates among people with a chronic disease remain low and also drops off after participation in clinical trials. Therefore, new approaches that are supported by evidence and theory are needed to increase exercise participation among people with a chronic disease. The application of recent advances in behaviour change science can be used to strengthen the knowledge base and provide recommendations for effective exercise interventions to support people with a chronic disease to become physically active and maintain participation. Exercise practitioners may play an essential role in promoting exercise and physical activity among people with a chronic disease in clinical and community settings. The following chapter will explore current approaches to understanding exercise behaviour and their limitations. An integrated model for understanding exercise behaviour will be explored, along with the role of exercise practitioners, mainly AEPs, in the delivery of evidence-based exercise programs for chronic disease management.

Chapter 2: Literature Review

Chapter Introduction

The chapter begins with an examination of the current approaches to understanding exercise behaviour that have been used to develop exercise interventions. Limitations of applying individual theories to understanding engagement in exercise are discussed and an integrated model for the study of exercise behaviour, the TDF is introduced and explained. Examples of how the TDF and behaviour change techniques (BCTs) and taxonomies have been applied to exercise research are presented. Exercise, as a component of the treatment model for chronic disease, is then explored. The role of exercise practitioners and their use of BCTs in the delivery of exercise programs is examined and the chapter concludes with research gaps and the rationale for the present study.

Approaches to Understanding Exercise Participation

Understanding the factors that influence exercise has been enhanced by the application of psychological concepts and theories (Biddle & Vergeer, 2019). Theoretical models of behaviour change provide an understanding of why and how people engage in exercise. Theoretical models can highlight the reasons people initiate exercise and continue their participation long-term. Exercise researchers and practitioners have used such theoretical models in the development of behaviour change interventions and programs. Several theories apply to exercise behaviour, and they can be organised into five general categories: (1) belief-attitude theories; (2) competence-based theories; (3) control-based theories; (4) stage models, and; (5) hybrid models (Biddle & Vergeer, 2019).

Belief-attitude theories refer to approaches that focus on the cognitive antecedents of behavioural intentions. Behavioural intentions are defined as the likelihood that an individual is prepared to invest in their desired target behaviour (Fishbein & Ajzen, 1975). An example of a belief-attitude theory is the theory of planned behaviour (Ajzen, 1991). Competence-based theories emphasise that individuals are more likely to engage in activities in which they feel confident, for example, Bandura's self-efficacy theory (Bandura, 1986). Bandura defined self-efficacy as an individual's judgement of their capabilities to perform the desired behaviour (Bandura, 1986). Control-based theories focus on the notion that individuals have the intrinsic desire to initiate and regulate their behaviour. An example is self-determination theory, in which autonomy describes the individual's psychological need for control (Ryan & Deci, 2000). Stage models, such as the transtheoretical model of behaviour change, theorise that behaviour change is a process in which the individual moves closer towards their intended goal (Prochaska & DiClemente, 1982). Hybrid models refer to theories that combine concepts from different behaviour change theories. For example, the health action process approach combines the stages of change with motivational factors to predict an individual's intention (Schwarzer, 2016).

Four theories have generated substantial research support and practical applications for enhancing exercise participation: (1) theory of planned behaviour (Ajzen, 1991); (2) self-efficacy theory (Bandura, 1977, 1986, 1997); (3) transtheoretical model of behaviour change (Prochaska & DiClemente, 1982), and; (4) self-determination theory (Ryan & Deci, 2000). These theories and their theoretical constructs are discussed in more detail in the following section.

Theory of planned behaviour. According to the theory of planned behaviour, intentions are the closest predictor of behaviour (Ajzen, 1991). Three constructs predict behavioural intention: (1) attitude; (2) subjective norms, and; (3) perceived behavioural control (Ajzen, 1991). Attitude is the overall appraisal that an individual makes concerning exercise (Ajzen, 1991). Subjective norm is the perceived social influence that other people (e.g., family, friends, or doctor) may place on an individual to perform exercise (Ajzen, 1991). Perceived behavioural control refers to an individual's perception of their ability to engage in exercise (Ajzen, 1991). Perceived behavioural control is theorised to predict behaviour directly, to the extent that perceived behavioural control could act as a substitution measure of actual behavioural control (Ajzen, 1991).

Self-efficacy theory. Self-efficacy is a theoretical construct originating within Bandura's social cognitive theory in which physiological, behavioural, and environmental factors work together to determine an individual's motivation for behaviour change (Bandura, 1977, 1986). Self-efficacy theory has been the main contribution from social cognitive theory to the exercise literature (Rhodes & Nigg, 2011). Bandura defined self-efficacy as the situation-specific belief or confidence a person has in their ability to perform a behaviour, influencing motivation and actual performance of the behaviour (Bandura, 1977, 1986). For example, an individual with high levels of self-efficacy for exercise is likely to have confidence in their ability to perform the behaviour and is more likely to persist with exercise in the presence of obstacles. Four antecedents may predict the level and strength of self-efficacy: (1) performance accomplishments; (2) vicarious experience (also referred to as modelling); (3) verbal persuasion, and; (4) physiological and affective states (Bandura, 1997).

Performance accomplishments describe how positive performance outcomes enhance a person's self-efficacy, whereas adverse performance outcomes reduce self-efficacy to perform the behaviour (Bandura, 1997). Vicarious experiences involve increases in self-efficacy through the observation of another person successfully engaging in the behaviour (Bandura, 1997). A person's self-efficacy is more likely to increase if they perceive the individual they are observing to be similar to themselves (Bandura, 1997). Verbal persuasion theorises that a persuader is more likely to enhance a listener's self-efficacy if they are perceived to be trustworthy and a credible source of information (Bandura, 1997). Verbal persuasion also refers to self-talk, for example, positive self-talk is more likely to increase self-efficacy, and negative self-talk is more likely to lower self-efficacy (Bandura, 1997). Physiological and affective states refer to arousal or specific emotions and feelings that influence self-efficacy (Bandura, 1997). For example, when people associate unpleasant arousal or emotions with exercise, self-efficacy can be reduced. Similarly, when a person experiences comfortable physiological sensations or pleasant emotions, self-efficacy can be enhanced. How an individual perceives and interprets their physiological arousal and emotions is more critical than the intensity of their reactions (Bandura, 1997). Outcome expectations are also an essential component of social cognitive theory, referring to the expectations an individual has about the outcomes of behaviour, which can influence a person’s self-efficacy (Bandura, 1977).

Self-efficacy is a strong correlate of exercise behaviour and due to its reciprocal nature, may be a determinant and a consequence of exercise behaviour (McAuley & Blissmer, 2000; Spence et al., 2006). The study of self-efficacy theory in exercise research has given rise to two types of self-efficacy; barrier efficacy and task efficacy (Blanchard et

al., 2007). Barrier efficacy refers to the confidence to overcome possible barriers to exercise, whereas task efficacy refers to the confidence to perform exercise itself (Bandura, 1997). Self-efficacy theory has been used to help predict exercise behaviour in observational (Sallis, Hovell, Hofstetter, & Barrington, 1992; Sternfeld, Ainsworth, & Quesenberry, 1999) and experimental studies (McAuley et al., 2007), particularly within the context of other theoretical models of behaviour, such as the transtheoretical model of behaviour change (Rhodes, McEwan, & Rebar, 2018).

Transtheoretical model of behaviour change. The transtheoretical model of behaviour change may be used to understand when, how, and why people change their behaviour (DiClemente & Prochaska, 1998). The model describes an individual's readiness to adopt healthy behaviour and their ongoing process through five stages: (1) precontemplation; (2) contemplation; (3) preparation; (4) action, and; (5) maintenance (DiClemente & Prochaska, 1998). Progression through the five stages is not linear; therefore, people may relapse to earlier stages at any time. Precontemplation is when the individual has no desire to change their behaviour within the next six months (DiClemente & Prochaska, 1998). Contemplation refers to the stage when individuals have a desire to change their behaviour within the next six months (DiClemente & Prochaska, 1998). Individuals in the contemplation stage are often aware of the advantages and disadvantages of changing their behaviour, however, they weigh heavily toward the disadvantages in this phase (DiClemente & Prochaska, 1998). The preparation stage is characterised by individuals being prepared to take action within the next month (DiClemente & Prochaska, 1998). In the action stage, individuals make changes in behaviour, however, they may relapse to earlier stages such as contemplation or preparation (DiClemente & Prochaska,

1998). Maintenance, the final stage, is characterised by the individual feeling comfortable with their behaviour change, and they are less inclined to relapse compared to the action stage (DiClemente & Prochaska, 1998). Maintenance is considered to last between six months and five years (Prochaska & DiClemente, 1982).

To progress through the stages of change, an individual requires awareness of the pros and cons of changing behaviour, confidence to initiate and maintain behaviour change, and several strategies to assist the behaviour change process. Decisional balance refers to the growing acknowledgement that the advantages of behaviour change outweigh the disadvantages. Decisional balance is particularly relevant for understanding and predicting behaviour change for people in the earlier stages (i.e., precontemplation, contemplation, or preparation stages; DiClemente & Prochaska, 1998). As an individual progresses through the stages, they become increasingly confident in their ability to change and maintain behaviour change in the face of barriers, and their level of self-efficacy rises. Strategies to assist the behaviour change process include several cognitive and behavioural strategies. Cognitive strategies (e.g., consciousness-raising and environmental reevaluation) are particularly relevant for understanding and predicting behaviour change for people in the earlier stages (i.e., precontemplation, contemplation, or preparation stages). For example, increasing a person's awareness about the benefits of exercise and prompting them to realise how insufficient exercise may affect people close to them (e.g., partner, children). Behavioural strategies (e.g., stimulus control) are more useful in the action and maintenance stages (DiClemente & Prochaska, 1998; Fisher et al., 2007). For example, using reminders and cues to encourage exercise participation such as phone reminders or leaving walking shoes at the front door.

Self-determination theory. Self-determination theory is a broad framework for understanding motivation for exercise (Ryan & Deci, 2000). According to self-determination theory, three psychological needs are essential in motivating human behaviour: (1) autonomy; (2) competence, and; (3) relatedness. Autonomy refers to the desire to engage in self-initiated activities, competence implies that individuals want to interact effectively with their environment, and relatedness refers to the need to feel connected to others (Ryan & Deci, 2000). Ryan and Deci (2000) theorised that all three requirements are essential for an individual's health and wellbeing.

Motivation exists on a continuum of varying degrees of self-determination ranging from high levels of self-determination and intrinsic motivation to low levels of self-determination and extrinsic motivation, and amotivation (Ryan & Deci, 2000). Intrinsic motivation refers to engaging in the behaviour as an "end in itself" (Ryan & Deci, 2000). For example, performing exercise for enjoyment, interest, feelings of satisfaction, competence, with a desire to continue. On the contrary, extrinsic motivation describes engaging in the behaviour as a "means to an end" (Ryan & Deci, 2000). For example, participating in exercise to satisfy an external pressure (e.g., from a doctor), for status or approval (e.g., from family or friends), to receive an external reward (e.g., money), or for health, fitness, or weight loss. Intrinsic motivation is more likely to promote long term maintenance of exercise (Ryan & Deci, 2000). Extrinsic motivation is more likely to be successful for short term motivation (e.g., at the initiation of exercise; Berger, Pargman, & Weinberg, 2006).

Emerging theories. Theory of planned behaviour (Ajzen, 1991), self-efficacy theory (Bandura, 1977), transtheoretical model of behaviour change (Prochaska & DiClemente, 1982), and self-determination theory (Ryan & Deci, 2000) focus on how people reflect on thoughts and feelings to make rational decisions about exercise participation. These cognitive-based theories work on the assumption that once enough information is available (e.g., about the health benefits of exercise) a person will make a rational decision to change their behaviour, and be motivated to change (Ekkekakis, 2017). This approach to understanding exercise motivation may overemphasise an individual's ability to make rational decisions about their behaviour change (Brand & Ekkekakis, 2018). As a contrasting approach, the affective-reflective theory of physical inactivity and exercise highlights how reflective and affective processes may work together to influence ongoing exercise participation (Brand & Ekkekakis, 2018).

Emerging theories emphasise the role of automatic motivation in exercise behaviour (Ekkekakis, 2017; Ekkekakis & Dafermos, 2012). Automatic motivation refers to automatic responses that register in the brain as either pleasant or unpleasant; without the need for conscious thought (Brand & Ekkekakis, 2018; Ekkekakis, 2013). Affect refers to the neurophysiological state consciously accessible as a simple, primitive, nonreflective feeling most evident in mood and emotion (Brand & Ekkekakis, 2018; Russell, 2003). The term affective valence characterises emotion and mood states as either good or bad, and pleasant or unpleasant (Ekkekakis, 2013). Negative emotions, such as anger or fear, have negative affective valence (Ekkekakis, 2013). Whereas positive emotions such as joy, have positive affective valence (Ekkekakis, 2013).

Affective valence may be related to exercise intensity. Experimental research shows adverse changes to affective valence during exercise above the ventilatory threshold (Ekkekakis, Parfitt, & Petruzzello, 2011). Ventilatory threshold refers to the point at which the amount of air entering and exiting lungs increases above the maximum amount of oxygen that can be used (i.e., maximal oxygen consumption) and is characterised by laboured breathing (ACSM, 2014). Most people reach ventilatory threshold during exercise performed between 50 and 75% of maximal oxygen consumption which is dependent on the individual's level of cardiorespiratory fitness and exercise experience (ADA, 2019). Ventilatory threshold occurs at higher intensities in regular exercisers compared to untrained individuals (ADA, 2019)

Affective valence experienced during exercise may have consequences for future exercise participation. Research suggests the displeasure experienced during high-intensity exercise may reduce untrained individual's likelihood to participate in future exercise (Brand & Ekkekakis, 2018; Ekkekakis & Lind, 2006). However, when able to self-select lower intensities, their experience was more pleasurable (Ekkekakis & Lind, 2006). Therefore, it has been recommended that opportunities be created for individuals to experience positive affective valence during exercise, such as exercising at intensities in which they feel comfortable (Ekkekakis & Lind, 2006). Pleasurable experiences during exercise may increase the likelihood of future participation, particularly among those who are physically inactive (e.g., individuals with or at risk of a chronic disease; Ekkekakis, Vazou, Bixby, & Georgiadis, 2016).

The affective-reflective theory of physical inactivity and exercise is a dual-process theory proposing that automatic affect and cognitive reflection work together to influence long-term participation in exercise (Brand & Ekkekakis, 2018). The theory attempts to explain why a physically inactive individual continues to remain in a state of physical inactivity (Brand & Ekkekakis, 2018). For example, an individual may be sitting on their couch when they remember their doctor's advice to start exercise (i.e., reflective process; Brand & Ekkekakis, 2018). This thought will trigger an automatic association with the individual's current state of physical inactivity (Brand & Ekkekakis, 2018). The assignment of either a pleasant or unpleasant valence determines whether the individual will change their state of inactivity or not (Brand & Ekkekakis, 2018). If the affective valence associated with their physical inactivity is more favourable than the negative valence associated with exercise, the person will be restrained from changing their inactive state (Brand & Ekkekakis, 2018). Therefore, the automatic affective valuation serves as the basis for a more reflective evaluation incorporating the role of rational thinking in behavioural choices (Brand & Ekkekakis, 2018). Affective-reflective theory of physical inactivity and exercise may provide an alternative explanation for why people remain in a state of physical inactivity, other than lack of motivation to change, as proposed in the theory of planned behaviour or self-determination theory (Brand & Ekkekakis, 2018).

Application of theory in exercise behaviour change. Systematic reviews based on observational studies in the general population have demonstrated the predictive power for the theory of planned behaviour, social cognitive theory, and the transtheoretical model of behaviour (Marshall & Biddle, 2001; McEachan, Conner, Taylor, & Lawton, 2011; Spence et al., 2006). A meta-analysis, which included 103 studies based on the theory of planned

behaviour reported a large effect size for the relationship between intention and exercise (McEachan, Conner, Taylor, & Lawton, 2011). In a meta-analysis focusing on social cognitive theory, a moderate association between self-efficacy and exercise behaviour was identified (Spence et al., 2006). A meta-analysis including 71 studies based on the transtheoretical model, found that differences in exercise levels depended upon participants' change status where differences were noted between those in the preparation stages and those in the action stages (Marshall & Biddle, 2001). A literature review by Teixeira, Carraca, Markland, Silva, and Ryan (2012) examined 66 studies grounded in self-determination theory and concluded that there was a positive relationship between autonomous forms of motivation and exercise. However, each of these reviews included only observational studies and therefore could not demonstrate whether theory-informed interventions were more effective than a control (Gourlan et al., 2016; Prochaska, Wright, & Velicer, 2008).

Gourlan et al. (2016) conducted a meta-analysis of randomised controlled trials to examine the efficacy of theory-based exercise behaviour change interventions. The review included 82 randomised controlled trials with a combined total of 19,357 participants (experimental N = 10,574 and control N = 8,783) and a mean age of 48.4 years (SD = 13.93). Studies consisted of mainly apparently healthy adults, however, also included adults who were previously physically inactive (23%, n = 18) and adults with T2DM (3%, n = 10). Theory-based interventions significantly influenced the exercise behaviour of participants (d = 0.31, 95% CI [0.24, 0.37]) compared to the control group (no intervention or intervention not based on theory) with a small to medium effect size on exercise behaviour (d = 0.31; Gourlan et al., 2016). The transtheoretical model (n = 31) was the

most frequently applied theory, followed by social cognitive theory (*n* = 16), theory of planned behaviour (*n* = 8), and self-determination theory (*n* = 5). The majority of studies (74%) were based on a single theory and no theory was found to be more effective than another (Gourlan et al., 2016). The results suggest that exercise interventions based on theory are more effective than a control group (Gourlan et al., 2016).

Although evidence suggests that interventions based on theory are more effective than a control, theory is not always applied to exercise interventions. Prestwich et al. (2014) conducted a review of exercise and healthy eating behaviour change interventions and found that 56% of interventions reported to have used a theoretical base in the design of the intervention. Another review used a theory coding scheme to reliably describe and measure how theories were used in interventions and how theory was tested in the intervention (Michie & Prestwich, 2010). A mean theoretical implementation score of 6.35 (*SD* = 2.09, *Mdn* = 6) was calculated for the studies reporting to have used a theoretical base and 90% of studies using a theoretical base did not report links between theoretical constructs and their mechanisms of change (Prestwich et al., 2014). Theory is not consistently applied in behaviour change research despite its efficacy (Gourlan et al., 2016; Prestwich et al., 2014). Further, when theory is applied, often studies do not provide sufficient information for the link between theoretical constructs and their mechanisms of action to be determined (Prestwich et al., 2014).

Less is known about the application of theory in exercise behaviour change interventions among clinical populations. Avery, Flynn, van Wersch, Sniehotta, and Trenell (2012) conducted a systematic review of 17 randomised controlled trials examining an

exercise intervention compared to usual care in people with T2DM. Thirteen studies reported using a theoretical base in the development of their intervention. Interventions underpinned by theory had a moderating effect on HbA1c levels and were associated with clinically significant improvements (a reduction of 0.21 to 0.44%) although it did not reach statistical significance (*SMD* -0.37, 95% CI [-0.49 to -0.25] vs. *SMD* -0.21, 95% CI [-0.72 to 0.29]). Among the theories used were: (1) social cognitive theory; (2) transtheoretical model of behaviour change; (3) social cognitive theory and transtheoretical model of behaviour change; (4) cognitive behavioural therapy and motivational interviewing, and; (5) cognitive behavioural therapy, motivational interviewing, and social cognitive theory. However, how the theories were used in intervention design and how they were combined was not examined. Establishing the link between theory and how theory exerts its effect is essential in the study of exercise behaviour change to inform the development of effective interventions to promote exercise participation among people with a chronic disease (Dombrowski et al., 2012; McEachan et al., 2011; Michie, Atkins, & West, 2014; Michie, Jochelson, Markham, & Bridle, 2009; Michie, Johnston, Francis, & Hardeman, 2005; Michie et al., 2008; Michie et al., 2015).

To date, reviews have not differentiated between the uptake and maintenance of exercise. Systematic reviews typically include interventions examining the uptake and maintenance of exercise. Many studies focus on the uptake of exercise, therefore, there is an overrepresentation of studies examining the uptake of exercise in systematic reviews. For example, in the systematic review by Avery et al. (2012) interventions ranged from eight weeks to two years. Combining studies that focus on short- and long- term changes in exercise behaviour is problematic because previous research suggests different theoretical

domains and constructs may be involved in the uptake and maintenance of exercise (Kwasnicka et al., 2016). Therefore, it is essential to examine theories separately for the uptake and maintenance of exercise for the management of chronic disease.

The application of theory in existing behaviour change interventions is further limited by the range of theories applied. For example, reviews by Gourlan et al. (2016) and Avery et al. (2012) identified theories limited to the transtheoretical model of behaviour change, social cognitive theory, theory of planned behaviour, and self-determination theory. However, it is unlikely that one theory can cover the full range of possible influences on exercise behaviour (Michie, Johnston, Abraham, et al., 2005) with a cross-disciplinary review identifying 83 theories that have been used to explain behaviour change (Davis, Campbell, Hildon, & Michie, 2014; Michie, West, Campbell, Brown, & Gainforth, 2014). Therefore, the application of a single theory to serve as a framework for understanding behaviour change is limited. However, studies examining the effectiveness of single versus multiple theories are limited by the failure to provide empirical evidence for their theoretical integration (Gourlan et al., 2016; Hagger, 2009; Hagger & Chatzisarantis, 2014). A system for theoretical integration is essential in the study of chronic disease in which there are often several unhealthy behaviours present and entrenched in people's everyday life, habits, and routines, making them difficult to change (Kelly & Barker, 2016). An integrated system for the application of multiple theoretical constructs is presented in the following section of the literature review.

Integrated Model of Behaviour Change

An integrated model of behaviour change provides a systematic method for studying theoretical constructs from multiple theories (Michie et al., 2015). The TDF allows for a systematic method to explore the full range of theoretical domains and constructs that may influence exercise behaviour (Cane, O'Connor, & Michie, 2012; Michie, Johnston, Abraham, et al., 2005; Michie et al., 2015). The TDF also provides an empirical method for linking behaviour change theory to their mechanisms of action (Michie et al., 2015). BCTs are the proposed mechanisms of action in behaviour change interventions and are regarded as the 'active ingredients' (e.g., goal setting and self-monitoring of behaviour; Michie et al., 2015). Taxonomies, such as the Coventry, Aberdeen and London-Refined (CALO-RE) taxonomy, provide a standardised list of BCTs according to domain-specific behaviours, such as healthy eating and exercise. Use of the TDF and BCT taxonomies provides a standardised method to use constructs from multiple theories in the development of exercise interventions (Michie et al., 2015). The development of the TDF and CALO-RE taxonomy, validation and refinements, and their application in exercise research are examined below.

Theoretical domains framework. The TDF brings together 33 behavioural change theories (e.g., the theory of planned behaviour, self-efficacy theory, transtheoretical model of behaviour change, and self-determination theory) and 128 theoretical constructs (e.g., self-efficacy, outcome expectancies; Michie, Johnston, Abraham, et al., 2005). Use of the TDF prompts consideration of several theoretical domains and constructs that may influence exercise behaviour (Cane et al., 2012). The 14 validated domains of the TDF are: (1) *knowledge*; (2) *skills*; (3) *social/professional role and identity*; (4) *beliefs about*

capabilities; (5) *optimism*; (6) *beliefs about consequences*; (7) *reinforcement*; (8) *intentions*; (9) *goals*; (10) *memory, attention, and decision processes*; (11) *environmental context and resources*; (12) *social influences*; (13) *emotion*, and; (14) *behaviour regulation* (Cane et al., 2012). Table 1 provides the framework with descriptions of each theoretical domain and their corresponding theoretical constructs.

Table 1. Theoretical Domains Framework

Domain	Description	Constructs
Knowledge	An awareness of the existence of something	Knowledge (condition/scientific rationale); procedural knowledge; knowledge of task environment
Skills	An ability or proficiency acquired through practice	Skills; skills development; competence; ability; interpersonal skills; practice; skills assessment
Social/professional role and identity	A coherent set of behaviour and displayed personal qualities of an individual in a social or work setting	Professional identity; professional role social identity; identity; professional boundaries; professional confidence; group identity; leadership
Beliefs about capabilities	Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use	Self-confidence; perceived confidence; self-efficacy; perceived behavioural control; beliefs; self-esteem; empowerment; professional confidence
Optimism	The confidence that things will happen for the best or that desired goals will be attained	Optimism; pessimism; unrealistic optimism; identity
Beliefs about consequences	Acceptance of the truth, reality, or validity about outcomes of behaviour in a given situation	Beliefs; outcome expectancies; characteristics of outcome expectancies; anticipated regret; consequences

Domain	Description	Constructs
Reinforcement	Increasing the probability of a response by arranging a dependent relationship between a response and a given stimulus	Rewards (proximal/distal, valued/not valued, probable/improbable); incentives; punishment; consequents; reinforcement; contingencies; sanctions
Intentions	A conscious decision to perform a behaviour or a resolve to act in a certain way	Stability of intentions; transtheoretical model and stages of change
Goals	Mental representation of outcomes or end states that an individual wants to achieve	Goals (distal/proximal) goal priority goal/target setting; goals (autonomous/controlled) action planning; implementation intention
Memory, attention, and decision processes	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives	Memory; attention; decision making; cognitive overload/tiredness
Environmental context and resources	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour	Environmental stressors; resources/material resources; organisational culture/climate; salient events/critical incidents; person x environment interaction; barriers and facilitators

Domain	Description	Constructs
Social influences	Those interpersonal processes that can cause an individual to change their thoughts, feelings, or behaviour	Social pressure; social norms; group conformity; social comparisons; group norms; social support; power; intergroup conflict; alienation; group identity; modelling
Emotion	A complex reaction pattern, involving experiential, behavioural and physiological elements, by which the individual attempts to deal with a personally significant matter or event	Fear; anxiety; affect; stress; depression; positive/negative affect; burn-out
Behaviour regulation	Anything aimed at managing or changing objectively observed or measured actions	Self-monitoring; breaking habit; action planning

Note. Adapted from "Validation of the theoretical domains framework for use in behaviour change and implementation research," by J. Cane, D. O'Connor, and S. Michie, 2012, *Implementation Science, 7*, p. 37.

Development. The TDF was created in 2005 by a group of behaviour change experts: 18 health psychology theorists, 16 health services researchers, and 30 health psychologists (Michie, Johnston, Abraham, et al., 2005). The TDF was created through a six-step consensus method: (1) identification of theories and theoretical constructs involved in healthcare behaviour; (2) simplification of theoretical constructs into theoretical domains; (3) evaluation of the importance of each theoretical domain; (4) interdisciplinary evaluation of the domains; (5) validation of the domains, and; (6) pilot interview questions for use in research (Michie, Johnston, Abraham, et al., 2005).

Step 1. The health psychology theory group identified all psychological theories and theoretical constructs related to health behaviour change (Michie, Johnston, Abraham, et al., 2005). Thirty-three theories and 128 constructs were identified (Michie, Johnston, Abraham, et al., 2005). Theories were categorised into motivation, action, or organisation theories (see Table 2; Michie, Johnston, Abraham, et al., 2005). Motivation theories related to behaviour change in individuals who have not yet established an intention to change behaviour (e.g., the theory of planned behaviour, social cognitive theory, self-determination theory; Michie, Johnston, Abraham, et al., 2005). Action theories referred to individuals who are motivated to change (e.g., self-regulation theory, social cognitive theory, transtheoretical model; Michie, Johnston, Abraham, et al., 2005). Organisational theories related to behaviour change at a social level (e.g., effort-reward imbalance, group theory, social influence; Michie, Johnston, Abraham, et al., 2005; Walker et al., 2003).

Table 2. Psychological Theories Identified in the Development of the TDF

Motivation Theories	Action Theories	Organisation Theories
Theory of planned behaviour	Learning theory	Effort-reward imbalance
Social cognitive theory	Operant theory	Demand-control model
Locus of control theories	Modelling	Diffusion theory
Social learning theory	Self-regulation theory	Group theory
Social comparison theory	Implementation theory	Decision-making theory
Cognitive adaptation theory	Goal theory	Goal theory
Social identity theory	Volitional control theory	Social influence
Elaboration likelihood model	Social cognitive theory	Person situation-
Goal theory	Cognitive behaviour therapy	contingency models
Intrinsic motivation theories	Transtheoretical model	
Self-determination theory	Social identity theory	
Attribution theory		
Decision-making theories		
Fear arousal theory		

Note. Adapted from "Making psychological theory useful for implementing evidence based practice: A consensus approach," by S. Michie, M. Johnston, C. Abraham, R. Lawton, D. Parker, A. Walker, 2005, Quality Safe Healthcare, *14*, p. 26.

Step 2. The health psychology theory group prioritized the 33 theories and 128 theoretical constructs identified in step one. A preliminary list of 10 domains was created: (1) *nature of the behaviour*; (2) *knowledge and skills*; (3) *goal intention*; (4) *beliefs about consequences; (5) beliefs about own capabilities; (6) goal plan*; (7) *social environment*; (8) *physical environment; (9) stress/emotion*, and; (10) *other* (Michie, Johnston, Abraham, et al., 2005). Seventeen constructs were identified as related to understanding and changing the health behaviour of individuals and 14 constructs were related to changing the behaviour of healthcare practitioners (Michie, Johnston, Abraham, et al., 2005).

Step 3. The health psychology theory group evaluated the importance of the 10 theoretical domains created in step two (Michie, Johnston, Abraham, et al., 2005). Theoretical domains were evaluated for coherence, overlapping constructs, and constructs omitted at step one (Michie, Johnston, Abraham, et al., 2005). Discussion among theorists led to several changes to the original domain list. For example, the *social environment* domain was subdivided into organisational and individual influences, and two domains were added: *memory, attention and decision processes* and *beliefs about evidence-based practise/guidelines* (Michie, Johnston, Abraham, et al., 2005).

Step 4. The health psychology theory group and health services research group conducted an interdisciplinary evaluation which led to further refinements (Michie, Johnston, Abraham, et al., 2005). For example, the interdisciplinary group considered *beliefs about evidence-based practice/guidelines* as part of the broader domain *social/professional role and identity* (Michie, Johnston, Abraham, et al., 2005). Theoretical

constructs were assigned to the new domains: *social/professional role and identity* and *memory, attention, and decision processes* (Michie, Johnston, Abraham, et al., 2005).

Step 5. Health practitioners validated the domain list generated at step four through a backwards validation task (Michie, Johnston, Abraham, et al., 2005). Theories and constructs generated by the health practitioners accurately reflected the theories and theoretical constructs allocated in previous steps (Michie, Johnston, Abraham, et al., 2005).

Step 6. Interview questions were created by the health psychology theory and health services research groups (e.g., do they know about the guideline?; Michie, Johnston, Abraham, et al., 2005). The questions were field-tested among managers and healthcare practitioners involved in the implementation of evidence-based practice (Michie, Johnston, Abraham, et al., 2005).

The final framework included 12 domains to explain behaviour change: (1) *knowledge and skills*; (2) *social/professional role and identity*; (3) *beliefs about capabilities*; (4) *beliefs about capabilities; (5) beliefs about consequences*; (6) *motivation and goals*; (7) *memory, attention and decision processes*; (8) *environmental context and resources*; (9) *social influences*; (10) *emotion regulation*; (11) *behaviour regulation*, and; (12) *nature of the behaviour* (Michie, Johnston, Abraham, et al., 2005).

Validation and refinement. The original TDF (Michie, Johnston, Abraham, et al., 2005) was refined by Cane et al. (2012). Thirty-seven behaviour change experts (unaware of the original framework) sorted the original domains and constructs using closed and open sort-tasks (Cane et al., 2012). Thirty-four constructs were removed for weak and vague definitions due to their negative influence on content validity (Cane et al., 2012;

Haynes, Richard, & Kubany, 1995). Eight domains in the validation study were similar to the original framework: (1) *knowledge*; (2) *skills*; (3) *social/professional role and identity*; (4) *memory, attention and decision processes*; (5) *environmental context and resources*; (6) *social influences*; (7) *emotion*, and; (8) *behaviour regulation* (Cane et al., 2012). Several amendments were made, including separation, clarification, and exclusion of original domains and constructs.

Three domains – *beliefs about capabilities*, *beliefs about consequences*, and *motivation and goals* – were retained, however, were separated into six new domains – *beliefs about capabilities*, *optimism*, *beliefs about consequences*, *reinforcement*, *intentions*, and *goals* (Cane et al., 2012). The separation of *motivation and goals* into two domains (i.e., *intentions* and *goals*) was indicated by the assignment of labels relating to intentions and goals in the sort-tasks (Cane et al., 2012). For example, participants labelled *goals* as relating to an end-state that is seen as a preferred outcome. In contrast, *intentions* were labelled as related to the resolve to either initiate or terminate a behaviour (Cane et al., 2012). *Beliefs about consequences* was separated into two domains where *beliefs about consequences* was retained and *reinforcement* was added to refer to associative learning (Cane et al., 2012). The *beliefs about capabilities* domain was separated to include the additional domain, *optimism*, where the construct refers to general disposition rather than specific capabilities required to achieve an outcome (Cane et al., 2012).

Environmental context and resources and *behaviour regulation* showed weak clustering (Cane et al., 2012). However, their constructs were consistently assigned to the original domain labels in the closed sort-task (Cane et al., 2012). This finding suggested

knowledgeable individuals were clear about constructs within their domains when domain labels were present. Therefore, the domains were retained in the refined framework (Cane et al., 2012).

Strengths and limitations. There are several strengths to the TDF. First, the framework is grounded in psychological theory (Cane et al., 2012; Michie, Johnston, Abraham, et al., 2005). Second, the framework simplifies and clarifies behaviour change theory making the theory more accessible to individuals involved in evidence-based practice implementation across different disciplines (Michie, Johnston, Abraham, et al., 2005). Third, the framework is more useful than applying one theory to understand behaviour as it covers a comprehensive range of relevant theoretical domains and constructs that may be involved in behaviour change (Cane et al., 2012; Michie, Johnston, Abraham, et al., 2005). The framework is versatile and can be used to collect qualitative (e.g., focus groups, interviews) and quantitative (e.g., questionnaires) data. The TDF has shown good validity – the original framework overlaps and builds on previous domains and constructs identified by other researchers in behaviour change (Fishbein et al., 2001; Michie, Johnston, Abraham, et al., 2005) and the refined framework provides strengthened evidence for the structure and content of the domains (Cane et al., 2012).

The TDF also has several limitations. Although the range of theoretical domains and constructs contained in the original framework is extensive, the list does not cover all theories of behaviour change (Cane et al., 2012; Hobbs, Campbell, Hildon, & Michie, 2011). The domain list cannot comprehensively identify all factors that may be involved in behaviour change such as those that are not psychological (e.g., physical barriers; Michie,

Johnston, Abraham, et al., 2005). However, the developers suggested that these barriers may be mediated by psychological processes represented by domain such as *beliefs about consequences*, *social/professional role and identity*, and *environmental context and resources* (Michie, Johnston, Abraham, et al., 2005). Just as the refined framework was an advance on the original framework by Michie, Johnston, Abraham, et al. (2005), future research is likely to identify additional theoretical domains and constructs important to behaviour change (Cane et al., 2012). Although the TDF identifies key theoretical domains and constructs, it does not seek to explain the causal processes between domains and constructs (Michie, Johnston, Abraham, et al., 2005).

Behaviour change techniques (BCTs) and taxonomies. Abraham and Michie (2008) developed a 26-item taxonomy of BCTs for exercise and healthy eating behaviour change interventions. The taxonomy provides standardised labels, definitions, and examples of BCTs applying to exercise and healthy eating interventions (Abraham & Michie, 2008). The 2008 taxonomy established a common language for intervention designers, reviewers, and practitioners to specify the content of behaviour change interventions (Abraham & Michie, 2008). Refinements were made to the original 26-item taxonomy producing the CALO-RE taxonomy (Michie et al., 2011). The 40-item taxonomy is provided in Table 3.

BCTs can be grouped by domains of theoretical domains (e.g., knowledge and skills) using the TDF (Cane et al., 2012; Cane, Richardson, Johnston, Ladha, & Michie, 2015; Michie, Johnston, Francis, et al., 2005; Michie et al., 2008) to study the underlying mechanisms through which theory-based BCTs exert their effects (Michie et al., 2015). A

previous study linking 35 BCTs to 11 theoretical domains from the original TDF showed good reliability across four researchers, with 71% agreement of 385 possible links (Michie et al., 2008).

Table 3. Coventry, Aberdeen and London-Refined Taxonomy Items

Number	Label
1	Provide information on consequences of behaviour in general
2	Provide information on consequences of behaviour to the individual
3	Provide information about others' approval
4	Provide normative information about others' behaviour
5	Goal setting (behaviour)
6	Goal setting (outcome)
7	Action planning
8	Barrier identification/problem solving
9	Set graded tasks
10	Prompt review of behavioural goals
11	Prompt review of outcome goals
12	Prompt rewards contingent on effort or progress towards behaviour
13	Provide rewards contingent on successful behaviour
14	Shaping
15	Prompting generalisation of a target behaviour
16	Prompt self-monitoring of behaviour
17	Prompt self-monitoring of behavioural outcome
18	Prompting focus on past success
19	Provide feedback on performance
20	Provide information on where and when to perform the behaviour
21	Provide instruction on how to perform the behaviour
22	Model/demonstrate the behaviour
23	Teach to use prompts/cues
24	Environmental restructuring
25	Agree behavioural contract
26	Prompt practice
27	Use of follow-up prompts
28	Facilitate social comparison

Number	Label
29	Plan social support/social change
30	Prompt identification as role model/position advocate
31	Prompt anticipated regret
32	Fear arousal
33	Prompt self-talk
34	Prompt use of imagery
35	Relapse prevention/coping planning
36	Stress management/emotional control training
37	Motivational interviewing
38	Time management
39	General communication skills training
40	Stimulate anticipation of future rewards

Note. Adapted from "A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: The CALO-RE taxonomy," by S. Michie, S. Ashford, F. Sniehotta, S. Dombrowski, A. Bishop, D. French, 2011, *Psychology and Health, 26*(11), p. 1479.

TDF application in exercise research. The TDF has been used in systematic reviews to explore exercise behaviour change among people with a chronic disease (Cox, Oliveria, Lahham, & Holland, 2017; Dobson et al., 2016; Glowacki, Duncan, Gainforth, & Faulkner, 2017). For example, a review of 13 studies (seven quantitative and six qualitative) identified seven TDF domains relevant to exercise participation among people with depression: (1) *beliefs about consequences*; (2) *beliefs about capabilities;* (3) *intentions*; (4) *environmental context and resources*; (5) *social influences*; (6) *emotion*, and; (7) *behaviour regulation*. Domains related to exercise engagement were *beliefs about consequences*, *social influences*, *emotion*, and *behaviour regulation* (Glowacki et al., 2017). Domains related to the hinderance of exercise engagement included: *emotion*, *environmental context and resources*, *beliefs about capabilities*, and *intentions* (Glowacki et al., 2017).

Similarly, Cox et al. (2017) reviewed 48 studies exploring exercise participation among participants with chronic obstructive pulmonary disease. All 14 domains of the TDF were endorsed by participants with chronic obstructive pulmonary disease with the most frequent being: *environmental context and resources* (n = 34), *knowledge* (n = 18), and *beliefs about consequences* (n = 16). *Optimism* and *memory, attention and decision processes* were the least endorsed domains related to exercise participation. Use of the TDF allowed qualitative and quantitative data to be combined in the systematic reviews and identified *emotion* as relevant to exercise participation among people with a chronic disease which has traditionally be excluded from theories to explain exercise behaviour change (Cox et al., 2017; Glowacki et al., 2017). For example, enhanced mood, enjoyment, and distraction were related to exercise participation. Low mood, lethargy and fatigue, presence

of mental health symptoms, stress, boredom, and lack of enjoyment hindered exercise participation.

The TDF has been used in qualitative research to explore exercise initiation among people with a chronic disease. For example, Nicholson et al. (2014) explored stroke survivors' perceived barriers and facilitators to exercise initiation following a cerebrovascular accident. Thirteen participants with a median age of 76 years (IQR = 69-83) participated in a semistructured interview (Nicholson et al., 2014). Participants reported themes consistent with 12 TDF domains in the original framework (Michie, Johnston, Abraham, et al., 2005). The most commonly reported domains were: *beliefs about capabilities*; *environmental context and resources*, and; *social influences* (Nicholson et al., 2014). *Beliefs about capabilities* was the most frequently reported domain related to the uptake of exercise, which encompassed feelings of control and self-efficacy (Nicholson et al., 2014). Participants reported negative affect as a barrier to exercise participation which had not been highlighted as a potential barrier in previous stroke studies (Nicholson et al., 2014). The results of the study identified potential targets for future interventions to assist people in the initiation of exercise after stroke (Nicholson et al., 2014).

The TDF has also been used to assess behaviour change during and after an exercise intervention (Penn, Dombrowski, Sniehotta, & White, 2013). Fifteen adults at risk of T2DM completed a semistructured interview 12 months following the conclusion of a supervised exercise intervention (Penn et al., 2013). The focus of the interview was on those who had increased exercise participation at six or 12 months post intervention (Penn et al., 2013). The domains identified as relevant to exercise participation included: (1)

intentions and goals; (2) *reinforcement;* (3) *knowledge*; (4) *social role and identity*; (5) *social influences*; (6) *skills and beliefs about capabilities*; (7) *behaviour regulation*; (8) *memory, emotion, attention and decision processes*, and; (9) *environmental context and resources* (Penn et al., 2013). The results of the study also highlighted program features relating to the *social influences* and *environmental context and resources* domains that were perceived as beneficial for initiating, enacting, and maintaining behavioural change (Penn et al., 2013). For example, participants valued the peer support system and the opportunity to use the gym facilitates free of charge for 12-months following the supervised intervention (Penn et al., 2013). The results of the study highlighted that different theoretical constructs may be involved in the initiation and maintenance of exercise among people at risk of chronic disease.

The TDF has been used to examine exercise maintenance among people with a chronic disease and those at increased risk of a chronic disease. Sweet et al. (2009) conducted semistructured interviews with 15 participants who had maintained their exercise participation after attending a supervised cardiac rehabilitation exercise intervention. Participants identified 11 domains related to the maintenance of exercise: (1) *social influences*; (2) *behaviour regulation*; (3) *belief about capabilities*; (4) *beliefs about consequences*; (5) *reinforcement*; (6) *emotion*; (7) *environmental contexts and resources*; (8) *goals*; (9) *optimism*; (10) *social/professional role and identity*, and; (11) *memory, attention, and decision processes*. The researchers concluded that the findings provided novel insights into the behaviour change factors that had rarely been examined within cardiac rehabilitation participants, such as *optimism*. Timmons, Griffin, Cogan, Matthews, and Egan (2020) explored exercise maintenance using qualitative measures in older adults

following a supervised exercise intervention. The qualitative study explored the perspectives of participants exercise maintenance after participation in a 12-week exercise intervention using the TDF to identify barriers and facilitators. Interviews revealed key facilitators such as social aspects and beliefs about the benefits of exercise, and barriers such as affordability and a general aversion to gyms (Timmons et al., 2020). The findings added to the existing research suggesting that different theoretical domains may be associated with the uptake and maintenance of exercise.

Few studies have examined the practices of exercise practitioners when it comes to how they facilitate behaviour change in their clients. Sweet et al. (2009) conducted semistructured interviews with exercise practitioners regarding the maintenance of exercise by participants with CVD after engaging in a supervised cardiac rehabilitation program. The exercise practitioners identified the same domains as their clients as related to exercise maintenance following the supervised intervention: (1) *social influences*; (2) *behaviour regulation*; (3) *belief about capabilities*; (4) *beliefs about consequences*; (5) *reinforcement*; (6) *emotion*, and; (7) *environmental context and resources.* However, exercise practitioners identified the *knowledge* domain as important, whereas their clients with the CVD did not. This finding highlights that an important area of further research is the examination of the differences between exercise practitioners and their clients in exercise behaviour change.

The TDF can be used to examine several theoretical domains that may influence exercise behaviour in people with a chronic disease, including cognitive, affective, social, and environmental domains that would typically be studied separately. Therefore, use of the TDF in exercise behaviour change can be used to identify theoretical domains that have

been omitted from exercise behaviour research previously. Evidence suggests that different theoretical domains may be involved in the initiation and maintenance of exercise participation among people with a chronic disease. Further, exercise practitioners and participants may view the role of these domains differently. Much of the research in chronic disease and exercise has applied the TDF retrospectively rather than prospectively to define the domains that have been targeted within an intervention. A summary of studies using the TDF in exercise research is provided in Table 5.

Table 4. Exercise Studies Using the Theoretical Domains Framework

	Knowledge	Skills	Social/Professional Role Identity	Beliefs about Capabilities	Optimism	Beliefs about Consequences	Reinforcement	Intentions	Goals	Memory, attention and decision processes	Environmental context and resources	Social influences	Emotion	Behaviour regulation
Penn et al. (2013)	X	X	X	X			X	X	X	X	X	X	X	X
Nicholson et al. (2014)	X	X	X	X		X				X	X	X	X	X
Dobson et al. (2016)	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cox et al. (2017)	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Glowacki et al. (2017)			X	X		X	X	X		X	X	X	X	X
Sweet at al. (2019)			X	X	X	X	X		X	X	X	X	X	X
Timmons et al. (2020)	X			X		X		X	X		X	X	X	X

Note. All studies used the refined TDF framework with 14 theoretical domains (Cane et al., 2012) except Nicholson et al. (2014) who used the original framework with 12 domains (Michie, Johnston, Abraham, et al., 2005).

BCTs and taxonomies application in exercise research. Taxonomies have largely been applied retrospectively in exercise research. Researchers have used taxonomies in systematic reviews to code interventions for the presence of BCTs among people at high risk of chronic disease (Dombrowski et al., 2012; Olander et al., 2013) and those with an established chronic disease (Avery et al., 2015; Cradock et al., 2017; Hankonen et al., 2014). Identifying the presence of BCTs in exercise interventions allows for the examination of which BCTs are associated with increases in exercise behaviour.

The presence of BCTs in exercise interventions is associated with exercise behaviour in people with a chronic disease. In a systematic review of people with T2DM the authors coded 17 interventions for the presence of BCTs from the CALO-RE taxonomy (Avery et al., 2012). Statistically significant associations were found between increased levels of exercise and the use of four BCTs: (1) *prompt focus on past success* ($Q = 10.72$, $p = .001$); (2) *barrier identification/problem-solving* ($Q = 8.16$, $p = .004$); (3) *use of follow-up prompts* ($Q = 5.07$, $p = .024$), and; (4) *provide information on where and when to perform exercise* ($Q = 4.21$, $p = .040$; Avery et al., 2015).

The presence of BCTs in exercise interventions have also been examined for their effectiveness on clinical outcomes in T2DM such as HbA1c. A clinically significant reduction in HbA1c (> 0.3%) is the primary outcome of T2DM treatment (ADA, 2014). *Prompt review of behavioural goals* and *provide information on where and when to perform behaviour* had statistically significant associations with improved HbA1c (*WMD* -0.32%, 95% CI [-0.44, -0.21]; Avery et al., 2015). Similarly, a systematic review by Cradock et al. (2017) investigated the effectiveness of BCTs in dietary and exercise

interventions for improving HbA1c and body mass in people with T2DM. The review included 13 trials and moderator analysis for only exercise behaviour revealed three BCTs associated with a clinically significant reduction in HbA1c: (1) *instruction on how to perform behaviour*; (2) *credible source*, and; (3) *behavioural practice/rehearsal*.

There has been some suggestion that the number of BCTs present in exercise interventions may be related to intervention effectiveness. In their systematic review of exercise interventions for adults with T2DM, Avery et al. (2012) demonstrated that interventions including a large number of techniques were associated with better outcomes. Interventions including 10 or more BCTs (-0.48, 95% CI [-0.67 to -0.30]) were associated with better outcomes than interventions reporting less than 10 techniques (-0.22, 95% CI [-0.42 to -0.03]). However, a review of dietary and exercise interventions for obese adults with comorbidities found no relationship between the number of BCTs present and intervention effectiveness (Dombrowski et al., 2012).

The presence of BCTs in exercise interventions does not explain *how* they exert their effect on exercise behaviour (Michie et al., 2015). Clusters of theoretically similar BCTs may be more relevant to exercise behaviour than the number of BCTs used (Michie, Abraham, et al., 2009). Michie, Abraham, et al. (2009) coded 122 studies ($N = 44{,}747$) for the inclusion of 26 BCTs Abraham and Michie (2008) used in healthy eating and exercise interventions. The authors hypothesised that a cluster of theory-based BCTs related to self-regulation derived from Control Theory (Carver & Scheier, 1982) would be more effective in changing behaviour than interventions not using conceptually similar BCTs (Michie, Abraham, et al., 2009). The five self-regulation BCTs were: (1) *intention formation*; (2)

provide feedback on performance; (3) *prompt self-monitoring of behaviour*; (4) *prompt specific goal setting*, and; (5) *prompt review of behavioural goals*. Interventions that combined *prompt self-monitoring of behaviour* with at least one other BCT derived from control theory were significantly more effective than the other interventions (Michie, Abraham, et al., 2009). A key finding of this study is that BCTs linked to theory are more effective than interventions not based on theory.

Most studies have examined intervention BCTs according to the delivery protocol. In one of the few studies to investigate participant use of BCTs, Hankonen et al (2014) found that most participants did not use the BCTs taught to them in the intervention. Participants (N = 239; 40–69 years) with recently diagnosed T2DM were taught to use 16 BCTs related to exercise (n = 8) and healthy eating (n = 8): (1) *goal setting*; (2) *action planning*; (3) *using prompts/reminders*; (4) *motivating oneself*; (5) *social support*; (6) *self-monitoring*; (7) *goal review*, and; (8) *preparing for/dealing with setbacks* (Hankonen et al., 2014). Thirty-six percent of participants used all BCTs at follow-up (Hankonen et al., 2014). The number of BCTs used was significantly related to BMI reduction among the intervention participants $F(2, 200) = 4.730$, $p = .010$, $\eta^2 = .045$. Participants who used all eight BCTs lost more weight ($M = -1.01$ kg/m^2, $SD = 2.45$) than those who used zero to five BCTs ($M = .04$, $SD = 1.34$). Participants who used six to seven BCTs increased their exercise significantly more than the control group $F(4, 431) = 2.653$, $p = .033$, $\eta^2 = .024$. Use of specific BCTs was not related to increases in exercise behaviour, however. A key finding from this study is that the presence of BCTs in an intervention protocol does not

necessarily mean the participant applies it. Therefore, it is crucial to examine the use of BCTs from the participant perspective.

In summary, BCTs have often been applied retrospectively. Systematic reviews are limited by the accurate reporting of BCTs in their interventions, which has traditionally been considered weak (Michie et al., 2018). Additionally, the presence of a BCT in an intervention does not mean that the participant will use that technique (Hankonen et al., 2014), suggesting that participants may prefer some techniques over others. Further, although the CALO-RE taxonomy provides a standardised list and common language, identifying the presence of BCTs in exercise interventions provides limited information about how and why they work. Grouping BCTs by TDF domains may provide more important information about how BCTs work in interventions to bring about behaviour change and can be applied prospectively to future exercise interventions. Table 6 provides a summary of the findings of the results using BCTs in exercise research.

Table 5. Systematic Reviews Evaluating Behaviour Change Techniques

Author (year)	Study	Population	Taxonomy	Outcomes	Techniques
Dombrowski et al. (2012)	Systematic review	Obesity	Abraham and Michie (2008)	Exercise behaviour	Provision of instructions, self-monitoring, relapse prevention, prompting practice
Olander et al. (2013)	Systematic review	Obesity	Michie et al. (2011)	Exercise behaviour; exercise self-efficacy	Teach to use prompts/cues, prompt practice; prompt rewards contingent on effort or progress towards behaviour
Hankonen et al. (2014)	Systematic review	T2DM	Michie et al. (2011)	Body mass index	Goal setting; goal review; social support
Avery et al. (2015)	Systematic review	T2DM	Michie et al. (2011)	Exercise behaviour	Prompt focus on past success; barrier identification/problem solving; use of follow-up prompts; provide information on where and when to perform behaviour Prompt review of behavioural goals; provide information on where and when to perform behaviour
Cradock et al. (2017)	Systematic review	T2DM	Michie et al. (2011)	Exercise behaviour; HbA1c; glucose control; body weight	Instruction on how to perform the behaviour; behaviour practice rehearsal; demonstration of behaviour; action planning

Evidence-based Practice in Chronic Disease Management

Evidence-based practice is a clinical decision-making framework that encourages practitioners to integrate the best available scientific evidence with clinical expertise and patient values (Dennis et al., 2008; Grimshaw, Eccles, Lavis, Hill, & Squires, 2012). Evidence-based practice was established with the formal development of evidence-based medicine (Dennis et al., 2008) and has expanded to allied health professions and exercise practitioners (i.e., fitness instructors, personal trainers, and AEPs; ESSA, 2015b; Fitness Australia, 2019). The effective management of chronic diseases relies on the application of evidence-based practice (WHO, 2013). The Australian Health Ministers' Advisory Council (2017) also endorses evidence-based practice in the management of chronic disease. Applying evidence-based behaviour change strategies ensures that safe and effective behaviour change strategies are used in exercise programs for the management of chronic disease. Evidence-based practice seeks to ensure the exercise practitioner remains up to date with current evidence. Evidence-based practice is not always used in chronic disease management. Evidence-based practice seeks to limit the application of strategies that rely on tradition, intuition, or other unproven methods (Dennis et al., 2008; Michie, Johnston, Abraham, et al., 2005). A study in the United States showed that 30 to 40% of patients did not receive evidence-based care, and 20 to 25% received care that was considered unnecessary (Grol, 2001; Schuster, McGlynn, & Brook, 2005). The behaviour change strategies used by exercise practitioners in clinical practice is mostly unknown. There are currently no studies in the literature that have examined exercise practitioner use of evidence-based behaviour change strategies in clinical practice. Therefore, exploring the practice of exercise practitioners is essential in establishing whether evidence-based behaviour change strategies are used with clients (Grimshaw et al., 2004).

Evidence-based practice in chronic disease management encompasses active engagement from clients. Active engagement requires the exercise practitioner to ensure their clients are central to their care and have an informed role in their healthcare (Australian Health Ministers' Advisory Council, 2017). Person-centred healthcare can empower individuals to play an informed role in the management of their chronic disease (Michie, Miles, & Weinman, 2003). Active engagement allows personal factors to be considered within the context of an individual's healthcare (AIHW, 2018a). For example, the effect of their chronic disease con social factors such as home, family, and work life. Effectively engaging an individual with a chronic disease empowers them to increase their knowledge of their condition, create appropriate health goals, and considers the individuals' values. People with a chronic disease are required to make decisions about health behaviour to improve their health daily; therefore, effective self-management is a crucial part of chronic disease management (AIHW, 2018a; WHO, 2013). Lifestyle management, including exercise participation, is fundamental to T2DM care (ADA, 2019). The ADA (2019) advocates for the collaboration of patients and healthcare practitioners to optimise behaviour change throughout all phases of T2DM management (ADA, 2019). Research suggests that participants may prefer behaviour change strategies and that these preferences may differ from the practitioners (Hankonen et al., 2014). The client's preferences in their healthcare need to be considered to optimise behaviour change interventions for people with a chronic disease. Therefore, the perspective of the individual with T2DM in their exercise behaviour change is crucial to enhance the evidence-base for effective exercise programs for T2DM treatment.

Mixed Methods Research

Mixed methods research design combines qualitative and quantitative approaches (Creswell, 2011). The study of chronic disease requires complementary research methods to quantify the effectiveness of treatment and qualify the patients experience over time (Holman, 1993). A mixed methods approach is necessary to extend the understanding of how best to manage chronic diseases and experiences (Casebeer & Verhoef, 1997). Qualitative and quantitative approaches can be applied to overcome the weaknesses and use the strengths of each approach (Teddlie & Tashakkori, 2009) while focussing on their relative strengths (Creswell, 2014).

Qualitative methods. Qualitative research methods have become an essential component of health research as they offer insight into the complex social, emotional, and experiential phenomena in chronic disease healthcare (Ritchie, Lewis, McNaughton Nicholls, & Ormston, 2013). Due to their complexity, chronic diseases benefit from being studied from qualitative and quantitative methods (Casebeer & Verhoef, 1997). Qualitative data capture rich data about the patients' lived experience, including health beliefs, attitudes, and behaviour through observation, interviews, or focus groups (Ritchie et al., 2013).

Qualitative content analysis facilitates the interpretation of identifiable themes and patterns in qualitative data. Deductive thematic analysis uses existing theory or prior research to identify key concepts or variables as coding categories (Potter & Levine-Donnerstein, 1999). A deductive approach to content analysis is more structured than an inductive approach (Hickey & Kipping, 1996).

Qualitative methods allow researchers to access areas nonamenable to quantitative research and can complement and refine quantitative data (Ritchie et al., 2013). For example, qualitative description can be conducted before quantitative analysis in areas that have

received previously limited investigation (Ritchie et al., 2013). A limitation of qualitative research is that results are not generalisable to the study population (Ritchie et al., 2013). The role of the researcher in qualitative research differs significantly from quantitative research. For example, the research is considered an instrument of data collection rather than inventories, questionnaires or machines in quantitative research (Lincoln & Denzin, 2003). Therefore, the qualitative researcher must describe relevant aspects of self, including biases, assumptions, and expectations that may influence the research (i.e., data analysis and interpretation; Greenbank, 2003).

Quantitative methods. Quantitative research involves the empirical investigation of observable phenomena via mathematical or statistical modelling (Bowling, 2014). Quantitative research begins with the collection of data based on a hypothesis or theory (Bowling, 2014). Relationships are studied by manipulating factors thought to influence the phenomena of interest while controlling other variables relevant to the experimental outcomes (Curtis & Drennan, 2013). For example, researchers might examine the relationship between exercise and measurable physiological effects such as weight loss, controlling for other key variables such as dietary intake (Curtis & Drennan, 2013). Quantitatively based questionnaires are also widely used in health research, with statistics such as the proportion of respondents in favour of a position commonly reported (Curtis & Drennan, 2013).

Quantitative research provides data expressed in numbers. Statistical tests can be applied to numerical data such as descriptive statistics (i.e., mean, median, and standard deviation) and inferential statistics (i.e., t-tests, one-way analysis of variance, regression; Pallant, 2016). Statistical analysis is used to derive information such as demographics, trends, and differences between groups (Pallant, 2016). Multivariate statistics such as multiple

regression, reduce data even further and provide information about which factors are attributable to differences between specific groups (Pallant, 2016). Quantitative research collects data via surveys, examining preferences through two-alternative, forced-choice studies, or examining error rates and time on task.

The goal of quantitative research is to measure and analyse causal relationships between variables (Denzin & Lincoln, 1995). The investigator and investigated should be separate entities; that is, the researcher should be able to study the phenomenon without influencing it or being influenced by it (Denzin & Lincoln, 1995). Methods adopted to ensure this independence include randomisation, blinding, highly structured protocols, and questionnaires with a predetermined range of possible responses (Denzin & Lincoln, 1995). Sample sizes in quantitative studies are larger than sample sizes in qualitative studies to ensure the representativeness of samples so that generalisations to the population can be made (Carey, 1993).

To date, mixed methods approaches have been underutilized in research about exercise behaviour change in chronic disease management. However, such methods can enrich our understandings. For example, qualitative research can be used to explore participant's experiences of barriers and facilitators to engagement in physical activity from initiation to maintenance. Through quantitative research, the use of strategies by exercise practitioners to promote exercise behaviour change and the factors associated with their use can be quantified. Research suggests characteristics such as age, gender, education, and length of experience relate to how practitioners treat and work with their clients (Resnick and Hart, 2003; Mast and Kadji, 2018). Complementing the participant's perspective with an understanding of which aspects of exercise practitioners' practice support and add to the existing knowledge base of exercise behaviour change, providing important implications for

clinical practice and education and training. For example, examining the demographic factors that are related to the use of BCTs can help with targeting of educational programs of exercise practitioners.

Research Gaps

Few studies of people with T2DM have examined exercise behaviour change from the perspective of the person. People may use BCTs differently to how they are intended in intervention delivery. Placing an individual with a chronic disease at the centre of their care is fundamental for effective chronic disease management. Therefore, understanding the perspective of the participant in their exercise behaviour change is particularly important. There is a gap in knowledge about differences in strategies between uptake and maintenance of exercise. There is emerging evidence that there might be differences, however, this requires further exploration. Most studies focus on uptake, rather than maintenance of exercise. Maintenance of exercise is essential in the treatment of chronic disease, such as T2DM, because the primary component of treatment requires ongoing and regular exercise. Very little is known about the practices of exercise practitioners and the specific BCTs that they use when working with people with a chronic disease and there is currently no standardised way of measuring the use BCTs used in exercise practice. Further, practitioner use of BCTs and associations with demographic factors is a research gap and needs to be further explored. Evidence-based practice is essential for the effective management of chronic disease and as such, identifying the perspective of the individual with a chronic disease and exercise practitioners will provide novel and much needed insight into effective exercise interventions for the management of chronic disease. A mixed methods design will be adopted to improve the understanding of exercise uptake and maintenance relating to people with a chronic disease. The approach allows for the examination of the research

problem from the perspective of the patient and the exercise practitioner. The first qualitative study will explore the views of people with a chronic disease about their behaviour change.

Rationale for the Present Study

The overall aim of this research is to improve the understanding of exercise uptake and maintenance among people with a chronic disease. The aims will be achieved by exploring the perspectives of people with T2DM about their behaviour change using the TDF framework and the use of BCTs by exercise practitioners to promote exercise participation among their clients with a chronic disease using the CALO-RE taxonomy. Specifically, the research questions are:

Study 1

(i) What are the behaviour change strategies associated with the uptake of a 12-week supervised exercise efficacy trial among adults with T2DM?

(ii) What behaviour change strategies are related to exercise maintenance after completion of the supervised exercise?

Study 2

(iii) How frequently are theory-based BCTs used by Australian exercise practitioners when working with clients with a chronic disease?

(iv) Which sociodemographic characteristics (i.e., gender, age, employment length, education, employment type, and setting) are associated with exercise practitioners use of theory-based BCTs?

Deductive thematic analysis will use the TDF framework to analyse the qualitative data using the TDF framework. The second quantitative study examines the use of BCTs used by exercise practitioners to promote exercise participation among their clients with a

chronic disease. An online questionnaire will measure how frequently BCTs are used by Australian exercise practitioners when working with clients with a chronic disease. Multivariate statistics will be used to identify which sociodemographic characteristics (i.e., gender, age, employment length, education, employment type, and setting) are associated with exercise practitioners use of theory-based BCTs. Qualitative results will guide the analysis of the quantitative data. Thus, the theoretical domains identified as relevant to exercise behaviour change in Study 1 will provide the rationale for clustering BCTs by related theoretical domain in the TDF. The connection between qualitative and quantitative data provides a foundation for the interpretation and discussion of results.

Chapters 3 and 4 will present Study 1 and Study 2, respectively. Each chapter presents a description of the research methods, including participant selection criteria, materials, procedures, and a description of how the data were analysed. The results are presented, and the chapters conclude with a summary of main findings. Chapter 5 brings together the qualitative and quantitative results for discussion and comparison. The results will be discussed in contrast to existing evidence in the literature. Practical implications will be discussed, including suggestions for clinical practice, education and training, implementation of exercise interventions in research, and strategies to promote the uptake and maintenance of exercise among people with T2DM. The strength and limitations of the study will be discussed, and future research directions presented. Chapter 6 will provide general conclusions of the research.

Chapter 3: Study 1

Behaviour change associated with uptake and adherence to a 12-week supervised exercise efficacy trial among adults with Type 2 diabetes mellitus

Chapter Outline

This chapter presents Study 1, a qualitative study that identified behaviour change strategies used by participants with T2DM who participated in an exercise efficacy trial. The chapter begins with a statement of the study aims followed by a description of the research method. The results of the study are then presented, and the chapter concludes with a summary of the main research findings. An in-depth discussion of the findings with reference to previous research, study limitations, and practical implications are provided in Chapter 5.

Study 1 Aims

(i) What are the behaviour change strategies associated with the uptake of a 12-week supervised exercise efficacy trial among adults with T2DM?

(ii) What behaviour change strategies are related to exercise maintenance after completion of the trial?

Method

The Study 1 adopted a secondary data analysis approach. Secondary data analysis is the retrospective analysis of existing data collected from a previous study. Secondary data analysis can be used to generate new knowledge or support for existing theories (Hinds, Vogel, & Clarke-Steffen, 1997; Sandelowski, 1997; Szabo and Strang, 1997; Thorne,

1994). Study 1 involved the re-examination of qualitative data relating to participant experiences of their involvement in an exercise efficacy trial. The efficacy trial and qualitative interviews formed part of the research student's original research program. Details of the efficacy trial study methodology have been published by ul Haq et al., (2014). The student's research focus subsequently shifted to exercise behaviour change, and a secondary data analysis was performed on existing data so that participants did not have to be reinterviewed. The original interviews were semi-structured in nature and related to participants experience in the efficacy trial and were therefore relevant for reexamination to generate new knowledge of behaviour change from the existing data. The following section presents an outline of the original interview study prior to addressing the procedure and process involved in the secondary data analysis (Thorne, 1994).

Original Interview Study Outline

Design. The original study design used qualitative semi-structured interviews.

Participants. Five participants who completed an exercise efficacy trial were eligible to participate in the qualitative study (n = 3 from the intervention group; n = 2 from the control group). Participants were eligible to participate in the qualitative study because they successfully completed an efficacy trial and 12 months had passed since the completion of the trial (to assess exercise maintenance).

Sampling and sample size. Participants with T2DM who completed an exercise efficacy trial were selected via purposive sampling (Tong, Sainsbury & Craig, 2007;

Liamputtong & Ezzy, 2005). Purposive sampling allowed for the specific sampling of people with T2DM who completed an exercise efficacy trial.

Procedure. The Austin Health Human Ethics Research Committee (H2010/03936) and the Victoria University Human Research Ethics Committee approved the study (HREC 12/214). Five participants were invited to participate in a semistructured qualitative interview. Participants were initially contacted via telephone by a study investigator who was unknown to the participants. Participants who indicated interest in the study were mailed a participant information and consent form (Appendices B and C). One week after the information had been mailed, the student researcher contacted the participants via telephone to arrange a time and location for the interview that was convenient for the participant. The student researcher was previously known to the participants from the efficacy trial. Four interviews were conducted in the Endocrinology and Cardiology Research Gymnasium at Austin Health and one at Victoria University Footscray Park Campus. Participants returned their signed written informed consent prior to the interview. With the permission of the participants, all interviews were audio-recorded to allow for accurate transcription and analysis.

An interview schedule guided the interviews (Appendix D). Interviews commenced with ice-breaker questions to reestablish rapport with the participant and to make them feel comfortable and at ease (e.g., how have you been, how is your day going?). The interview consisted mostly of open-ended questions in which participants shared their experiences of their participation in the efficacy trial in either the intervention or active control group. The main purpose of the interview was to explore the participant's perceptions and experiences

of T2DM and exercise before, during, and after their involvement in the efficacy trial. The content of the questions remained the same in each interview as indicated by the interview schedule, however, the order in which they were presented varied with the flow of conversation. For example, sometimes participants answered more than one question at a time without needing to be prompted. Participants were prompted to discuss their exercise participation, beliefs, and attitudes before, during, and after the trial. For example, participants were asked "why didn't you perform any exercise before joining the study?" and "how much exercise do you do now?" Clarification and elaboration probes were used to explore constructs raised throughout the interview (Patton, 2002). For example, participants were asked "why was that important to you?" when discussing the benefits of exercise.

At the conclusion of the interview, participants were thanked for their involvement and asked about their interest in participation in future research. Interviews ranged in duration from 45 to 60 minutes. Information about participants' demographics and medical histories were collected during the trial and supplemented with information later gained in the interviews with participants.

Participants' audio-taped interviews were transcribed verbatim. The student researcher listened to recordings and read transcripts numerous times to ensure the accuracy and inclusion of all relevant information. Confidentiality was maintained by replacing or removing identifying names and details to ensure that participants were not identifiable through quotations and descriptions. Pseudonyms were used in the reporting of participant data.

Data analysis. The original study used inductive content analysis to systematically organise the interview data into a structured format (Tong, Sainsbury & Craig; Liamputtong & Ezzy, 2005).

Secondary Data Analysis

Methodological considerations. The nature and compatibility of the data for secondary data analysis was discussed between the research student and the student's supervisors. The original data was considered to be compatible due to: (1) the use of semistructured interviews in the original research, and; (2) the role of the student in collecting and analysing the original qualitative data (Thorne, 1994). The open-ended dialogue of the original interviews were guided by the study participants, rather than the researcher, to elicit rich and descriptive data. The use of semi-structured interviews encouraged the study participants to tell their own stories in a way that emphasised factors that were important to them. The interviews allowed the exercise intervention to be contextualised into the participants broader life and management of their chronic disease, providing scope for additional analysis of the facilitators and barriers faced by participants and the strategies used to overcome them when initiating and maintaining exercise. The role of the student researcher in collecting and analysing the original data made it suitable and convenient for secondary analysis (Szabo and Strang, 1997).

Ethical considerations. Ethical considerations of secondary data analysis were discussed with the student researcher and supervisory team. Participant consent was reasonably assumed given the similarity to the original interview study, and the deidentification and anonymization of participants (Morrow, Boddy, and Lamb, 2014).

Data analysis. Secondary data analysis was applied deductively to the original dataset using the revised TDF (Atkins et al., 2017; Cane et al., 2012). Interview transcripts were coded by: (1) reading interview transcripts; (2) considering their relevance to the definitions of the domains, and; (3) attributing key text to their most relevant domain (Atkins et al., 2017). This directed content analysis technique is guided by theory to interpret meaning from the content of qualitative data (Hsieh & Shannon, 2005). The student researcher and two additional researchers (the student researcher's supervisors) independently coded two interviews and compared results to improve the reliability of coding by minimising experimenter bias arising from the student researcher who delivered the exercise sessions to participants (Patton, 2002).

Microsoft Excel was used for data organisation, storage, and analysis. The student and supervisors met frequently to address coding challenges and agree on coding guidelines to increase the reliability of the analysis. The coding guideline was updated iteratively during the analysis to reflect justifications and resolutions to coding disagreements after consensus was achieved (Atkins et al., 2017; Cane et al., 2012). Two target behaviours were coded and defined as: (1) the adoption of exercise by participants (i.e., entry into and completion of the efficacy trial, either in the intervention or active control group), and; (2) the maintenance of exercise (i.e., engagement in exercise after the completion of the efficacy trial; Atkins et al., 2017; Cane et al., 2012). Neither references to previously performed exercise nor references to other health behaviours (e.g., dietary changes) were coded. Key quotes were assigned to a single domain and text was not coded more than once (i.e., into more than one domain).

A matrix chart was constructed using data from all five interviews. For example, key quotes corresponding to the *reinforcement* domain from all five interviews were entered into a table with the TDF domains (row) against the uptake and maintenance phase (columns). The number of quotes belonging to each domain were tallied. A domain was described as 'dominant' if it applied to at least 80% of participants (Hill, Thompson, & Nutt Williams, 1997). For example, if a key quote was identified in at least four of the five interviews then the domain was considered to be a dominant theme. The dominant domains are presented in the results section with exemplar quotes from participant interviews.

Sample size. An adequate sample size for this deductive research was based on sufficient data saturation referring to the extent to which TDF domains were adequately represented in the data to allow for analysis (Saunders et al., 2018).

Results

Participant demographics. Five participants completed the qualitative interview. Three participants had been randomised to the intervention group and two participants to the active control group. Table 10 displays information about each participant. Two participants were male, and three participants were female, with an age range of 48 to 83 years. All five participants were born in Australia and spoke English as their first language. One participant was employed full-time, three were either retired or semiretired, and one was a full-time carer for a child with a disability. All participants had T2DM diagnosed by a specialist medical consultant at the Endocrinology Department at Austin Health and the length of time since diagnosis ranged from four to 26 years. All participants were obese according to body mass index classification with values ranging from 30.1 to 41.6 kg/m^2

(National Heart Lung and Blood Institute, 1998). Participants' HbA1c ranged from 6.1 to 8.4% indicating adequate to poor control (ADA, 2014). Participants had several comorbidities including hypertension, dyslipidaemia, obstructive sleep apnoea, and osteoarthritis. One participant had psychiatric diagnoses of posttraumatic stress disorder, anxiety, and depression. Participants were considered physically inactive on entry into the efficacy trial, meaning that they had not participated in the minimum recommended amount of exercise for at least three months preceding their participation in the trial.

Table 6. Participant Demographics

	Age	T2DM	HbA1c	BMI	VO_{2peak}	Comorbidities	Group	Occupation
Nate	64	6	6.1	35.8	25.6	PTSD, anxiety, depression, dyslipidaemia, OSA, OA, obesity	Active control	Retired, full military pension
Claire	48	4	6.5	41.6	21.2	OSA, hypertension, obesity	Intervention	Employed fulltime
Brenda	50	8	7.8	30.1	18.1	Dyslipidaemia, hypertension, obesity	Intervention	Fulltime carer
Ruth	59	6	8.4	37.6	20.9	Dyslipidaemia, hypertension, obesity, OA	Active control	Semiretired
David	83	26	8.3	30.7	17.4	Obesity	Intervention	Retired

Note. Names are pseudonyms; Age = age in yr at time of interview; T2DM = yr since diagnosis; HbA1c = %; BMI = Body mass index ($kg \bullet m^2$); VO_{2peak} = peak oxygen consumption ($ml \bullet kg^{-1} \bullet min^{-1}$); PTSD = Posttraumatic stress disorder; OSA = Obstructive sleep apnoea; OA = Osteoarthritis.

Use of behaviour change strategies by participants with T2DM before and after participation in an exercise efficacy trial. The most common behaviour change strategies were represented by the following TDF domains: (1) *reinforcement*; (2) *beliefs about consequences*; (3) *behaviour regulation*; (4) *social influences*; (5) *emotion*; (6) *beliefs about capabilities*; (7) *environmental context and resources*; (8) *social/professional role and identity*, and; (9) *goals* (see Table 11). Appendix E includes all quotes that were attributable to each domain for all participants.

Table 7. Represented TDF Domains in Participant Interviews

	Participants		Total
Domain	***n***	**%**	***n***
Reinforcement	5	100	30
Beliefs about consequences	5	100	23
Behaviour regulation	5	100	23
Social influences	4	80	20
Emotion	4	80	19
Beliefs about capabilities	4	80	11
Environmental context and resources	4	80	11
Social/professional role and identity	4	80	11
Goals	4	80	10
Skills	3	60	4
Intentions	2	40	8
Memory	1	20	3
Knowledge	1	20	1
Optimism	0	0	0

Reinforcement. Health improvements were seen as reinforcing efforts to take up the exercise sessions and maintain the behavioural change after the conclusion of the trial. Exercise participation was reinforced through noticing and placing value on improvements in blood glucose and blood pressure readings at the end of each exercise session. Although the measurements were taken at the beginning and conclusion of each exercise session as safety measures and not as a deliberate behaviour change strategy, participants used observed changes in these measures as motivation to continue exercise. Participants also reported diabetes related benefits in the maintenance of exercise. Participants reported benefits to their physical health plus aspects of their mental health and general wellbeing in the maintenance stage.

> *Whilst here you took my blood sugar levels before and after…sometimes it had gone down as much as 3.0…which just shows us that we must have been doing some work to get rid of the thing (diabetes). (David)*

> *It's good for your diabetes, it's good for your wellbeing, it's good for your mental health. It just makes you feel good. You just feel like you've got a lot more energy afterwards...if you make that effort you really do get the rewards. (Brenda)*

A secondary theme to emerge from the *reinforcement* domain related to participants who were randomised to the control group in the efficacy trial. These participants described the opportunity to continue exercise under the supervision of the researchers acted as a reward for completing the study in the active control group.

> *I was hoping to get the exercise (intervention group), but I didn't, I got the stretching. And I thought oh well they said I'll get the exercise when it's finished, that's fine I'll just do that. So, I approached the stretching with a good attitude, and I think that helped. (Ruth)*

Behaviour regulation. Behaviour regulation was related to the maintenance of exercise after the conclusion of the efficacy trial. The most commonly reported actions relating to behaviour regulation were habit and self-monitoring. Participants who had maintained their exercise participation discussed their new exercise habits and routines, especially how they maintained their participation around other daily and weekly commitments (i.e., work and family).

> *I've just stuck with it. I've been encouraged to do it. It's just a matter of doing it, just accepting it as part of life. Ah look, I'm retired. I don't have to go to work. So, it takes me less than 10 minutes to get to the gym from my home. That 35 to 45 minutes in the gym. Then, say, 10 minutes to get home again. That's my days' work. That's what I put it down to. I had eight hours to do it before, now I do it in an hour and a half. That's not hard to do. (Nate)*

Participants reported self-monitoring of exercise outcomes, rather than the self-monitoring of exercise behaviour itself. These exercise outcomes included heart rate, blood pressure, blood glucose, and to a lesser extent, body weight. Participants also described self-monitoring fitness levels through activities of daily living, for example, the ease or difficulty of climbing stairs and completing chores. Self-monitoring these outcomes

facilitated their exercise behaviour by highlighting whether they were doing adequate exercise or needed to increase their exercise levels.

> *I understand my body so much better than what I did two or three years ago. I can even tell you what my heart rate would be right now. So, I know how I feel, I know what my blood pressure would probably be around. I understand me, better. And that's just because of the (exercise) regularity. (Ruth)*

Participants who were inactive at the time of the interview were able to identify barriers and attempted to problem-solve around these for the future.

Beliefs about consequences. Participants reported that the specific health benefits relating to T2DM, such as improved glucose control, was a primary motivation to join the efficacy trial. Participants often reported that they believed exercise would assist them in the management of T2DM.

> *Before the study I was struggling. I just couldn't do anything really (to improve my blood sugars). I just couldn't make improvements. I just felt (my diabetes) is spiralling out of control. So that's why I said look I'll do the (exercise) program. I really wanted to improve my blood sugars. I knew that the medication really wasn't working on it's on. So that's why I decided to join at the time. (Brenda)*

Participants made clear connections between their exercise participation and improvements in their health and fitness levels which facilitated their adherence to the exercise sessions during the efficacy trial. Participants in the intervention and active control groups reported improvements in cholesterol levels, blood pressure, obstructive sleep

apnoea, osteoarthritis, and mood. Participants also reported increases in fitness, including cardiorespiratory fitness, musculoskeletal strength and endurance, and joint range of motion. The value of maintaining health and fitness improvements was related to the maintenance of exercise after the trial. Participants also attributed negative health consequences to periods of insufficient exercise. Participants reported fear of regressing to inactive states (i.e., sedentary behaviour before they participated in the efficacy trial). The fear of losing health and fitness gains was an important facilitator for the maintenance of regular exercise.

Social influences. Participants discussed the importance of the therapeutic alliance with staff from the research team. Participants described how the research team contributed to positive experiences during the exercise sessions by creating an environment in which participants felt "safe" and "cared for". Participants also described feeling accountable to the research staff, which further facilitated their adherence to the exercise sessions during the efficacy trial. During the maintenance phase, participants acknowledged that exercising independently (i.e., without the supervision of exercise practitioners) reduced their motivation to exercise and exposed them to injury. Participants who continued to volunteer for AEP students (outside of the research setting) reported a similar therapeutic alliance to the efficacy trial, and this was related to the maintenance of regular exercise.

> *It was three days a week I was compelled to get out of bed otherwise I was disappointing someone else by not showing up to an appointment. I was motivated to get out of bed. Whereas, prior to any of those activities, I was in bed at 11 o'clock in the morning. (Nate)*

> *It was just really nice, the two students I had were really great. They were always pleasant to talk to, I looked forward to going, I looked forward to the company, I actually felt as if people cared about me, so that was really nice. They did the stretching with me rather than just me doing it. So, I really liked that. (Ruth)*

Participants described how social influences could be a barrier and a facilitator to exercise particularly at the initiation of exercise. Participants described that social comparison to other participants in the efficacy trial facilitated their adherence to the exercise sessions. For example, participants described seeing other people like them (with T2DM, obesity, and of a similar age) as positive and motivating. Participants also reported that sharing health information was helpful and made them feel connected to others.

> *I can be honest and say that one thing I used to hate about the gym in the old days, before this (efficacy trial), was that I always felt very self-conscious of the fact that I wasn't the perfect shape or the perfect size…When I came here, majority had issues with their weight as well. You felt like you had kinship with everybody, and they all encouraged each other. There were a few people that we became quite friendly. We talked a little bit about our outside lives as well. We compared things and talked about stuff and we had common interests. So that side of it was really good. (Claire)*

Emotion. Participants described negative affect as a symptom of T2DM. Negative affect was often described as a barrier to exercise participation before the efficacy trial. Participants reported that positive affect derived from the exercise sessions was a facilitator to their participation. Participants reported an elevation in mood, a reduction in anxiety and stress, and perceived increased energy and vitality during and after exercise sessions.

Participants in the intervention and active control groups experienced the positive affective benefits. For example, a participant from the control group described feeling "happier" and "relaxed" after completing stretching sessions. During the maintenance phase, participants associated negative affect with periods of insufficient exercise, which then acted as a facilitator to recommence exercise.

> *I guess (diabetes) just gives you like a feeling of low mood as well. You just don't feel motivated to get out there and do something. (Prior to the efficacy trial) I was feeling very lethargic. I was feeling really, extremely tired all the time. Sort of heavy headed and foggy in your thinking, like you're not sort of thinking clearly. I just felt I was never going forward, just sort of staying the same, not really improving. (Brenda)*

Beliefs about capabilities. Participants described being unsure of their exercise capabilities at the beginning of the efficacy trial; however, the baseline testing sessions introduced exercise that prepared participants for the exercise sessions. The constant supervision and gradual progression in exercise intensity during weeks one to three of the intervention also provided graded opportunities for participants to experience mastery which promoted an increase in their self-confidence and self-efficacy that facilitated their adherence to the exercise sessions. Participants in the active control group described stretching as a gradual physical preparation to later perform higher intensity exercise.

> *I would have said (high intensity exercise) is too hard for somebody like me. The study made me realise that it's not. The stretching was a good way of getting me used to coming in three times a week. It was a really good way of getting me into the routine without physically hurting me. I've got more confidence with exercise since then and*

> *that's because I've learnt that they never give you too much. They always give you something that's doable. They don't get you to run a marathon if you can't walk six hundred yards. So that's one of the things that I've liked about this, everything that they've ever given me is doable at the time. So, if you had have said to me, "go and leg press 157kg 20 times" I would have said, "no". But if you said it to me now, I'd give it a go. So, it's just helped me prepare over time. So, I think it was good preparation. (Ruth)*

Two participants described that by participating in the structured and supervised exercise sessions, they had gained the self-confidence and self-efficacy required to exercise independently after the conclusion of the trial, which was related to their maintenance in exercise.

> *I don't need this (study) anymore, I don't need to come but I did like coming. So, the want is still there. Beforehand it was both the need and the want. Now I don't need to, I have other outlets (for exercise). (Claire)*

Environmental context and resources. Participants reported that joining the efficacy trial was a strategy to (temporarily) overcome a financial barrier to exercise, including the cost of commercial gym memberships and personal training. Affordability was a barrier for many participants, as the majority were either retired or received government assistance. The cost of accessing a local gym after the efficacy trial was a barrier to maintaining their participation in exercise. Strategies to overcome financial barriers included purchasing a less costly type of gym membership such as foundational or over fifties options. However, these strategies often resulted in access barriers such as long

waiting periods for new gyms to be built and limited access to gyms during off-peak hours. Close vicinity of a gym to home or work and low membership costs generally facilitated attendance to exercise. Some participants continued to volunteer for AEP students to overcome the financial barrier.

Participants reported several aspects of the efficacy trial that facilitated their initial uptake of the exercise sessions. For example, many participants spoke of the proximity of the exercise sessions to their homes, the flexibility of exercise sessions times to fit around existing schedules, and the physical location of the research gym on hospital grounds was perceived as safe for participants with a chronic disease to exercise.

Social/professional role and identity. The behavioural and personal qualities of participants emerged as a dominant theme in the uptake and maintenance of exercise. Participants from the intervention and active control groups described social responsibility or social obligation as a positive contributor to their participation in the research trial. Participants valued their contribution as research volunteers.

> *I strongly believe in research and contributing back to my society and my community. If it comes up again, I'd be perfectly happy to contribute. It's the same reason you give blood isn't it? You attend functions and you go to fetes it's all about that giving back to your community. You know, if me being involved in this study helps one other person then it's great. (Claire)*

Two participants continued to volunteer as a strategy to maintain their exercise after the efficacy trial. Two active control participants became volunteer clients for AEP students at Victoria University, and at the time of their interviews, these participants were still

participating in regular exercise through their volunteer roles. Participants described the reciprocal relationship in which both parties benefited while having a responsibility to teach other as a factor related to exercise maintenance.

> *I prefer to (exercise) here (at VU with the students) because I actually like the fact that I'm giving them their hours, makes me feel useful and by the same token I get something useful out of it. And, honestly, I think it's a two-way street. You guys need stuff for the study and us guys need the exercise. We need people to look at us, with diabetes and with heart problems, look at us and you get your facts and figures and we get the help. (Ruth)*

Social/professional role and identity was also identified as a barrier to exercise participation, particularly in the maintenance phase. One participant described how her role as a mother of four, including a child with a disability, provided a significant obstacle to exercise maintenance after completing the trial.

> *I find that there's always been obstacles along the way to stop you from going to the gym. There are always things that pop up that prevent you from doing daily exercise. I guess with me, I've got a big family so there's always things going on with the children. My daughter with Down Syndrome has a lot of health issues so I have to address those. That takes a chunk of time out of your days. She has a lot of visits to the Children's Hospital so that sort of takes a whole day. And that restricts me from going to the gym. And just busy family life I guess, because I've got other children as well. I've got a mother who's not well as well and I've been trying to attend to her as well. I guess these things prevent me from doing daily exercise. Before you know it a*

whole month has gone by and you haven't done any exercise. You know, it is hard. I guess family commitments really prevent you from living the way you prefer to live. You're not free when you've got a family. It's different. I just can't say I'm going to go to the gym every day at this time, because things pop up. (Brenda)

Goals. Participants reported that health-related outcome goals facilitated their participation in exercise. At the initial uptake of the exercise sessions and entry into the efficacy trial, health-related outcome goals were primarily related to improving blood glucose control for T2DM management. In the maintenance phase, health-related outcome goals broadened from blood glucose management to include goals that targeted the multimorbidities of T2DM, such as high blood pressure and cholesterol levels. Fitness outcomes such as cardiorespiratory fitness and musculoskeletal strength were also discussed as important to the ongoing participation in exercise during the maintenance phase. No participants discussed outcome goals related to left ventricular diastolic dysfunction, however.

Summary of main findings. The most commonly represented TDF domains were *reinforcement, beliefs about consequences, behaviour regulation, social influences, emotion, beliefs about capabilities, environmental context and resources, social/professional role and identity,* and *goals*. All participants reported factors consistent with *reinforcement, behaviour regulation,* and *beliefs about consequences* domains.

Reinforcement. Participants reported that the acute health outcomes of exercise, such as immediate reductions in blood glucose levels, were reinforcing to their adherence. Participants made clear connections between their exercise participation and their current

health state, which is related to the concept of consequents that is linked to the *beliefs about consequences* and *reinforcement* domains.

Beliefs about consequences. The perceived health benefits from participating in exercise were a facilitator to initiate exercise. Participants were initially interested in the health outcomes related to T2DM, such as improved blood glucose.

Behaviour regulation. *Behaviour regulation* was relevant to the maintenance of exercise beyond the intervention period. Self-monitoring of health outcomes related to T2DM, and its multimorbidities, was a dominant theme.

Social influences. The therapeutic alliance between the participant and research staff was reported as a vital factor to exercise participation. Exercising with others with T2DM, who were also overweight, and of a similar age was motivating for participants.

Emotion. Positive and negative affect were the most commonly reported constructs consistent with the *emotion* domain. Exercise engagement in the efficacy trial was associated with enjoyment and positive affect which contributed to exercise adherence. Participants described enhanced mood lasting for some time after the exercise session. Participants discussed negative affect in response to periods of not exercising, and this was often described as a motivating factor to reengage with exercise. Some participants described negative affect as a symptom of T2DM, which acted as a barrier to participating in exercise.

Beliefs about capabilities. Participants were unsure of their exercise capabilities at the beginning of the trial. Participants discussed needing the support provided by the trial to initiate exercise; however, had progressed to exercising independently after the trial.

Participants randomised to the active control group discussed how the stretching gradually prepared them for higher intensity exercise after completing the stretching program.

Environmental context and resources. *Environmental context and resources* was particularly relevant as a barrier to exercise participation. Participants discussed financial barriers to exercise, such as the cost of gym memberships after the conclusion of the efficacy trial. Joining the clinical trial was identified as a way to overcome the barrier of financial restraint, at least temporarily. The research gym provided a safe environment for participants to exercise.

Social/professional role and identity facilitated the initiation and maintenance of exercise participation. Social responsibility was a contributor to the uptake of the exercise sessions, as participants described that they valued their contribution as volunteers.

Goals related to the health outcomes of exercise participation and facilitated exercise initiation and maintenance.

Chapter 5 provides a discussion of the findings in more detail. The results will be discussed regarding the existing empirical evidence. Practical implications of this qualitative research are discussed, including suggestions for clinical practice, education, and training, implementation of exercise interventions in research, and strategies to promote the uptake and maintenance of exercise among people with T2DM. The limitations of the study will also be discussed. The discussion will bring together the results of Study 1 and Study 2 for comparison. Study 2, a quantitative study that examined the BCTs used by exercise practitioners to promote exercise participation among clients with a chronic disease, is presented in the next chapter.

Chapter 4: Study 2

Behaviour change techniques used by Australian exercise practitioners to promote exercise participation among clients with a chronic disease

Chapter Outline

This chapter presents Study 2, a quantitative study. The chapter begins with an introduction and a statement of the research aims. The study methods are then outlined, including the participant selection criteria, materials, procedure for conducting the online questionnaire, and a description of how data were analysed. The results are then presented, and the chapter concludes with a summary of the main findings. Chapter 5 will include a detailed discussion of the results and comparison to the existing empirical evidence, study limitations and practical implications.

Study 2 Aims

The purpose of this quantitative study was to examine BCTs used by Australian exercise practitioners to promote exercise participation among clients with a chronic disease. The study aims were to examine:

(i) How frequently are theory-based BCTs used by Australian exercise practitioners when working with clients with a chronic disease?

(ii) Which sociodemographic characteristics (i.e., gender, age, employment length, education, employment type, and setting) are associated with exercise practitioner use of theory-based BCTs?

Pilot Study of the Behaviour Change Index-Exercise Practitioners – (BCI-EP)

The BCI-EP was developed by Associate Professor Melinda Craike and the research student because no such measure existed to measure behaviour change strategies used by exercise practitioners. To ensure items were relevant and appropriate, the measure was pilot tested prior to the main study.

Aims of the Pilot Study. The BCI-EP was pilot tested before the main study to: (1) assess the appropriateness and clarity of items for the target group of exercise practitioners, and; (2) determine the length of time required to complete the questionnaire (i.e., face validity).

Context and Initial Item Development. To identify the BCTs of exercise practitioners, a measure had to first be developed to measure the BCTs. The BCI-EP was developed because no such measure existed. The BCI-EP was pilot tested among a cross-section of Australian exercise practitioners (i.e., the target population of the main study). The questionnaire was administered in the pilot study to test its face validity. The BCI-EP was developed to measure BCTs used by exercise practitioners when working with clients, based on the 40-item CALO-RE taxonomy of BCTs (Cane et al., 2012; Michie et al., 2011; Appendix F). Items were developed to measure each of the 40 items of the CALO-RE taxonomy, from the perspective of exercise practitioners. Participants were asked to rate 40 statements on a 4-point Likert-type scale corresponding to their frequency of use of BCTs. Response options ranged from 1 (*never*) to 4 (*most of the time*). Example items included "how often do you provide general information on the benefits of exercise for all people?" and "how often do you encourage the client to develop an action plan?". To ensure each question was clear to the respondent, either a specific example "For example, tell the client

about the general health benefits of exercise" or a definition was provided, "An action plan is a detailed plan for participation in exercise, including when (i.e., day of the week, time of day), in which situation and/or where to perform exercise sessions (i.e., at home, in the park, at the gym)."

Pilot Study Procedures. The student researcher and supervisor's industry contacts identified potential participants for the pilot study. The student researcher sent an email to potential participants to determine their interest in participating in the study, including the participant information and consent form (Appendix G). The student researcher contacted potential participants seven days after the introductory email to determine their interest in being involved in the study and to answer any questions they had about the study. Those who agreed to be involved signed and returned the consent form and completed a hard copy of the questionnaire (Appendix H). Once the questionnaire was completed, the student researcher arranged a time to conduct the interview. Interviews were conducted either over the phone or face-to-face, depending on the location and preference of the participant. Face to face interviews took place in a location preferred by the participant and were guided by an interview schedule (Appendix I). During the interview, participants were asked open-ended questions regarding the ease of answering the questions, identification of any ambiguous items, their understanding of the items, and suggestions for how to improve the clarity of items. Interviews ranged in length from 30 to 45 minutes, and the student researcher took detailed notes during the discussion.

Pilot Study Findings and Implications. Fifteen exercise practitioners participated in the pilot study (nine AEPs and six fitness professionals). The total sample included nine

females and six males and 60% (n = 9) of the exercise practitioners were aged between 25 and 34 years. Approximately 50% (n = 8) of the participants had between four and seven years of employment experience as an exercise practitioner. The results of the pilot study showed that the online questionnaire took approximately 10 to 15 minutes to complete, which was reported by the participants to be an acceptable length of time. During the interviews, exercise practitioners identified that several questions were unclear and required clarification (i.e., questions 3, 13, 14, and 40). For example, multiple participants asked for clarification about who "other" people referred to in question 3 (e.g., discuss what other people will like, approve or disapprove about the client's exercise participation). Based on this feedback, refinements were made to all questions by providing examples that were more specific to the exercise practitioner's role. For example, in question 3 an example of "other" people was provided, such as the client's general practitioner.

Following these refinements, the BCI-EP was used in the main study.

Main Study Method

Design. A cross-sectional survey research design was used to measure exercise practitioner use of BCTs in clinical practice. The study was exploratory in nature with the purpose to examine potential relationships between the use of BCTs and exercise practitioner characteristics. Therefore, the study aimed to explore potential relationships between demographic factors among EPs in the use of BCTs in clinical practice.

Sampling and sample size. A snowball sampling method was used which relied on referrals from the research team to recruit participants. Due to the exploratory nature of the

study, an adequate sample size was determined based on statistical associations being found.

Participants. Australian exercise practitioners were eligible to participate. Exercise practitioners were defined as professionals who deliver exercise services to clients, including gym instructors, personal trainers, and AEPs. The study presented in this chapter focused on a subgroup of these exercise practitioners who reported to work with clients with chronic diseases. Therefore, data from exercise practitioners who self-identified as providing exercise services to clients with a chronic disease were included in the analysis.

Materials. Participants were asked to complete an online questionnaire that included demographic questions and the BCI-EP (Appendix J). The demographic questions consisted of 11 categorical questions measuring gender, age, length of employment, role, employment type (full-time, part-time, or casual), highest education level completed (including exercise-related and nonexercise related qualifications), employment postcode and residential postcode, employment type and setting, and clientele type (i.e., most common client conditions). No identifying information was requested or recorded.

Procedure. The Victoria University Human Research Ethics Committee (HRE 17-119) approved the study. Participants were invited to complete an online questionnaire administered through a secure online platform (Qualtrics). Australian exercise practitioners (e.g., gym instructors, personal trainers, and AEPs) were eligible to participate in the study. A snowball sampling method was used which relied on referrals from the research team to recruit participants. The study was advertised through relevant industry-based organisations, including Physical Activity Australia and ESSA, as well student and

supervisor contacts. ESSA distributed information about the study and a link to the online questionnaire via their monthly electronic newsletter. The email was brief, and included the title of the project and that participation was voluntary and responses confidential. The email had a web-link to the online survey, which participants were able to access directly. Participants were directed to an information to participants page, which clearly outlined the nature of the research, the aims, and any potential risks to participants. Participants were required to check a box indicating their consent and confirming that they were 18 years and older before proceeding to the survey (Appendix K). The data collection period was from October to November 2017. Due to the recruitment methods used, it was not possible to calculate a response rate for the study.

Data analysis. Data were exported from Qualtrics into a compatible file for use with IBM Statistical Packages for the Social Sciences (SPSS). All data analyses were completed using SPSS version 25.0 for Mac. The primary data analysis used descriptive statistics and ordinary least squares linear regression (referred to as regression from this point forward) to address the research aims. To address the study's first aim, descriptive statistics were used to examine how frequently the 40 individual BCTs were used by exercise practitioners when working with clients with a chronic disease. To address the study's second aim, regression testing was used to examine the relationship between sociodemographic variables and the use of BCTs by exercise practitioners. Regression analysis allows for the controlling of independent variables (i.e., exercise practitioner characteristics) on dependent variables (i.e., use of BCTs), in order to make predictions Pallant, 2016).

Preliminary data analysis was performed prior to main data analysis. Preliminary data analysis included an analysis of missing values and testing assumptions of normality, according to recommendations from Pallant (2016).

Preliminary data analysis.

Missing value analysis. Missing value analysis showed that 18 responses were missing from the dataset. Performing complete-case analysis would yield a loss of 5 cases (9.2%) as these participants had missing values on one or more items. A Little's (1988) Missing Completely at Random Test was performed and confirmed that data were missing at random ($\chi^2 = 54.823$, DF = 43, $p = .107$). Therefore, missing values were replaced with predicted values using Expectation Maximization to retain the sample size (Tabachnick & Fidell, 2019). After replacing missing values, the data were examined for the assumptions of multivariate analysis, including sample size, multicollinearity and singularity, and outliers.

Multicollinearity and singularity. Pearson correlations between independent (i.e., exercise practitioner characteristics) and dependent variables (i.e., use of BCTs) were examined. The results are displayed in Appendix K and show mostly weak relationships between independent and dependent variables. Next, correlations between seven independent variables (i.e., gender, age, employment length, employment role, postgraduate qualification, socioeconomic location, and hospital employment) were examined and returned values below 0.7 – suggesting no multicollinearity. Tolerance and Variance Inflation Factor values were inspected to further detect the presence of multicollinearity. Tolerance values ranged from .494 to .944 and Variance Inflation Factor values ranged

from 1.059 to 2.025, indicating that the multicollinearity assumption had not been violated, therefore, all variables were retained (Pallant, 2016)

Outliers. All independent and dependent variables were examined for outliers, which were indicated by standardised residual values above 3.3 (or less than -3.3; Tabachnick & Fidell, 2019). To identify outlier cases, the critical chi-square value using the number of independent variables as the degrees of freedom was used (Tabachnick & Fidell, 2019). There were seven independent variables; therefore, the critical value was 24.32 (Tabachnick & Fidell, 2019). The maximum Mahalanobis distance value was 13.929; therefore, no cases exceeded the critical value. Casewise diagnostics returned two cases with a residual value below -3.0 for one of the regression models (-3.102 and -3.919). The Cook's Distance value was inspected to check if these cases were influencing the results for the model as a whole (Tabachnick & Fidell, 2019). According to Tabachnick and Fidell (2019), cases with a value larger than 1 may be a potential problem, however, in this model the maximum value for Cook's Distance was .450; therefore, all cases were retained.

Normality, linearity, homoscedasticity, independence of residuals. The Normal Probability Plot of the Regression Standardised Residual and the Scatterplot were inspected for the distribution of scores (Pallant, 2016). The residuals were examined for normal distribution of the predicted dependent variable scores. The Normal Probability Plot was examined to assess whether the points fell in a reasonably straight diagonal line from bottom left to top right. In the scatterplot of the standardised residuals, the residuals were roughly rectangularly distributed, with most of the scores concentrated in the centre (along the 0 point). Examination of residual scatterplots revealed some violations of the

assumptions of normally distributed errors, linearity, and homoscedasticity. Violations of the assumptions weaken rather than invalidate the analysis (Tabachnick & Fidell, 2019). Because the sample included exercise practitioners, and not the general population, the sample was not expected to be normal. Transformations were not applied because they are not recommended for variables which are known to be naturally skewed and may pose problems with interpretability of results (Tabachnick & Fidell, 2019). Due to violations of assumptions of normality of errors, linearity, and homoscedasticity, parametric analyses were cross-referenced with nonparametric analyses. Nonparametric statistics are not dependent on normal and symmetrical sampling distributions (Pallant, 2016).

Cross-reference with nonparametric statistics. Due to some violations in the assumptions of multiple regression, nonparametric tests were used to cross-reference the results of parametric tests. Spearman Rank Order Correlation (rho) nonparametric statistics were used to ensure that the parametric findings were accurate. When bivariate correlations were tested using Spearman's rho, the same relationships between variables were observed (Appendix L).

Main data analysis.

Frequency of use of individual BCTs. Descriptive statistics were used to examine how frequently the 40 individual BCTs were used by exercise practitioners when working with clients with a chronic disease to address the study's first aim.

Clustering of theoretically similar BCTs. Analysing 40 individual BCT items would require considerable statistical power. Therefore, it was appropriate to analyse clusters of conceptually similar BCTs as recommended by developers of the CALO-RE taxonomy

(Michie et al., 2011). BCTs were clustered into conceptually similar groups using the TDF (Cane et al., 2012). Eighteen (out of the 40 individual BCTs) were assigned to one of six clusters based on recommendations by Michie et al. (2015). The six clusters reflect six of the nine theoretical domains that emerged as important to exercise uptake and maintenance in Study 1 (i.e., *social influences*, *goals*, *reinforcement*, *behaviour regulation*, *environmental context and resources*, and *beliefs about consequences*).

Scale creation and reliability. To address study aim two, the six clusters were created into scales (see Table 12). Items in each scale were summed to derive a total score, with higher scores reflecting more frequent use of BCTs from that cluster. Cronbach's alpha coefficient was used to determine the internal consistency of each of the scales consisting of more than two items (i.e., *social influences*, *goals*, and *reinforcement*; Pallant, 2016). The Cronbach alpha coefficient for *social influences* and *goals* scales was .75 and .80, respectively, indicating an acceptable level of internal consistency (DeVellis, 2016). The Cronbach alpha coefficient for the *reinforcement* scale was .57. After checking the 'Alpha if Item Deleted', the effect of removing item *T12 Prompt rewards contingent on effort or progress towards exercise* improved the Cronbach alpha coefficient to .60, therefore, it was removed from the final reinforcement scale. The items in each scale, their range of scores, and Cronbach alpha coefficients are shown in Table 12.

Table 8. BCT Scale Items

Scale	Items	Range	α
Social influences	T03 Provide information about others approval T22 Model/Demonstrate exercise T28 Facilitate social comparison T29 Plan social support/social change T30 Prompt identification as role model/position advocate	5-20	.75
Goals	T05 Goal setting (behaviour) T06 Goal setting (outcome) T07 Action planning T10 Prompt review of behavioural goals T11 Prompt review of outcome goals	5-20	.80
Reinforcement	T13 Provide rewards contingent on successful behaviour T14 Shaping T40 Stimulate anticipation of future rewards	3-12	.60
Behaviour regulation	T16 Prompt self-monitoring of behaviour	1-4	N/A
Environmental context and resources	T23 Teach to use prompts/cues T24 Environmental restructuring	2-8	N/A
Beliefs about consequences	T31 Prompt anticipated regret	1-4	N/A

Independent and dependent variables coding. To facilitate regression analysis, seven categorical independent variables were dummy coded as: gender (0 = *male*, 1 = *female*), age (0 = *35 years and over*, 1 = *34 years and under*), AEP (0 = *no*, 1 = *yes*), length of employment (0 = *8 or more years*, 1 = *up to and including 7 years*), postgraduate qualification (0 = *no*, 1 = *yes*), employment in a hospital (0 = *yes*, 1 = *no*). Cut-off points were chosen based on median splits (i.e., the balancing of group numbers). The larger group was coded as '1' to strengthen correlation analysis.

The Index of Relative Socioeconomic Advantage and Disadvantage was used to measure socioeconomic advantage and disadvantage for the area in which exercise practitioners worked (Australian Bureau of Statistics [ABS], 2018). The index summarises information about the economic and social conditions of people and households within an area, including relative advantage and disadvantage measures where a low score indicates relatively greater disadvantage and a lack of advantage in general and a high score indicates a relative lack of disadvantage and greater advantage in general (ABS, 2019). Postcode of employment was used to determine socioeconomic index scores into quintiles from 1 to 5. A dummy variable was created and quintiles four and five were coded as 0 = *high socioeconomic advantage* and quintiles one to three coded as 1 = *low socioeconomic advantage*.

The six dependent variables included total scale scores for six clusters: (1) *social influences*; (2) *goals*; (3) *reinforcement*; (4) *behaviour regulation*; (5) *environmental context and resources*, and; (6) *beliefs about consequences*.

Bivariate correlations. Bivariate correlations between seven predictor variables (i.e., gender, age, role, employment length, postgraduate qualification, socioeconomic advantage, and hospital employment) and six scales (i.e., outcome variables) were conducted before the regression analyses to determine which dependent variables would be entered into the regression models (Pallant, 2016). Pearson product-moment correlation coefficient (r) was used to describe the strength and direction of the linear relationship between independent variables (i.e., gender, age, role, employment length, postgraduate qualification, socioeconomic advantage, and hospital employment) and dependent variables (i.e., BCT scales). No significant correlations were found between the predictor variables and social influences and goals domains; therefore, these scales were not used in the regression model. Table 13 displays tabulated results of bivariate correlations.

Table 9. Correlations of Exercise Practitioner Characteristics and BCT use

	Social influences	Goals	Reinforcement	Behaviour regulation	Environment context & resources	Beliefs about consequences
Gender	.104	.057	-.036	.179	.287*	0.33
Age	-.203	.022	-.261	-.383**	-.034	-.306*
Employment	-.105	.059	-.179	-.121	-.168	-.141
Role	-.190	.111	-.454**	-.207	-.011	-.170
Postgrad	-.017	-.119	-.068	-.126	.031	-.098
Socio	.058	.044	.160	-.121	.123	.162
Hospital	-.061	-.044	.145	.085	-.074	.084

Note. n = 54. Employment = employment length in yr. Role = AEP or other. Postgrad = postgraduate qualification. Socio = socioeconomic advantage of work location. Hospital = employment in hospital setting or other.

*p < .05. **p < .01.

Predictors of BCT use. To address study aim two, a series of regression analyses were conducted to examine predictors of BCT use. Four models were created: (1) *reinforcement*; (2) *behaviour regulation*; (3) *environmental context and resources*, and; (4) *beliefs about consequences*. Seven independent variables were entered into the models simultaneously: gender, age, AEP, length of employment, postgraduate education, socioeconomic advantage of work location, and hospital employment.

Results.

Exercise practitioner demographics. Figure 1 displays a flowchart of participants who responded to the online questionnaire. Fifty-four (50.5%) exercise practitioners reported to work with adults with a chronic disease and were, therefore, eligible to be included in the analysis. Thirty-nine of the 54 participants were female (72.2%), and most were aged between 25 and 34 years (*n* = 30, 55.6%). Almost half of the participants were located in Victoria (*n* = 25, 46.3%). Most of the sample were AEPs (*n* = 44, 81.5%) and held a postgraduate qualification (*n* = 35, 65.0%). One-third of the sample was employed in a hospital setting (n = 18, 33.3%). Table 14 contains full demographic data of exercise practitioners.

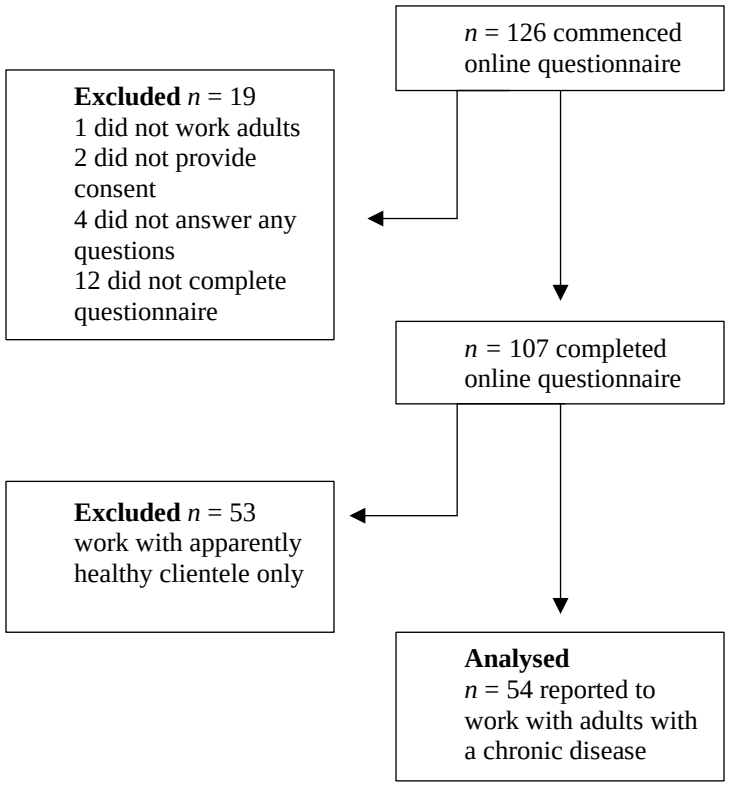

Figure 1. Flow Diagram of Participants

Table 10. Exercise Practitioner Demographics

Characteristic	*n*	%
Gender (*n* = 54)		
Female	39	72.2
Male	15	27.8
Age (*n* = 54)		
18-24 yr	6	11.1
25-34 yr	30	55.6
35-44 yr	11	20.4
45-54 yr	4	7.4
55-64 yr	2	3.7
≥ 65 yr	1	1.9
State (*n* = 50)		
New South Wales	8	14.8
Queensland	7	13.0
South Australia	7	13.0
Victoria	25	46.3
Western Australia	2	3.7
Northern Territory	1	1.9
IRSAD[a] (*n* = 50)		
Quintile 1 (most disadvantaged)	8	14.8
Quintile 2	7	13.0
Quintile 3	6	11.1
Quintile 4	9	16.7
Quintile 5 (most advantaged)	20	37.0
Employment length (*n* = 54)		
< 1 yr	4	7.4
1-3 yr	12	22.2
4-7 yr	13	24.1
8-10 yr	8	14.8
> 10 yr	17	31.5
Role[b]		
AEP	44	81.5
Group exercise instructor	8	14.8
Gym instructor	4	7.4
Personal trainer	4	7.4
Allied health assistant	2	3.7
Physiotherapist	1	1.9
Sports coach	1	1.9

Characteristic	***n***	**%**
Number of roles (*n* = 54)		
One	48	88.9
Multiple	6	11.1
Employment type (*n* = 54)		
Fulltime (one role)	19	35.2
Fulltime (multiple roles)	20	37
Parttime	9	16.7
Casual/contract	6	11.1
Education (*n* = 54)		
Certificate IV in Fitness	2	3.7
Diploma of Fitness	2	3.7
Undergraduate degree in Exercise Sciences/similar	15	27.8
Post graduate qualification in Exercise Sciences/similar	35	64.8
Work setting (*n* = 54)		
Hospital	18	33.3
Large corporate gym/community health centre (> 500 members)	9	16.7
Medium size gym/fitness centre (100-500 members)	6	11.1
Small studio	7	13.0
Train clients from home/visit client's home/work	1	1.9
Other	3	5.6
Educational facility (school/TAFE/university)	3	5.6
Allied health clinic	4	7.4
Multiple locations	3	5.6

[a]IRSAD = Index of Relative Socioeconomic Advantage and Disadvantage relating to location work location of exercise practitioner. Adapted from "*Census of population and housing: socio-economic indexes for areas (SEIFA)*," by ABS, 2018. [b]Participants could select multiple responses corresponding to number of roles held.

Frequency of BCT use. Table 15 displays the frequency of use of individual BCTs to address study aim one. The six most frequently used techniques reported by exercise practitioners were: *T05 Goal setting (behaviour)*; *T22 Model/demonstrate exercise*; *T13 Provide rewards contingent on successful behaviour*; *T06 Goal setting (outcome)*; *T10 Prompt review of behavioural goals,* and; *T11 Prompt review of outcome goals*.

Table 11. Frequently Used BCTs

BCT	***n***	**%**
T05 Goal setting (behaviour)	53	98.1
T22 Model/demonstrate exercise	53	98.1
T13 Provide rewards contingent on successful behaviour	52	96.2
T06 Goal setting (outcome)	51	94.4
T10 Prompt review of behavioural goals	49	90.7
T11 Prompt review of outcome goals	49	90.7
T31 Prompt anticipated regret	45	83.3
T29 Plan social support/social change	44	81.5
T40 Stimulate anticipation of future rewards	42	77.7
T23 Teach to use prompts/cues	39	72.7
T24 Environmental restructuring	38	70.4
T03 Provide information about others approval	35	64.8
T30 Prompt identification as role model/position advocate	34	63.0
T28 Facilitate social comparison	31	57.4
T03 Provide information about others approval	28	51.9
T14 Shaping	24	44.4
T07 Action planning	23	43.0
T16 Prompt self-monitoring of behaviour	13	24.1

Note. $n = 54$.

Use of the clusters of theoretically similar BCTs were analysed using mean scores of BCTs scales and are provided in Table 16. The most frequently used clusters were *goals* and *social influences*.

Table 12. Mean Scores of BCT Scales

TDF Scale	Mean
Goals	3.67
Social influences	3.05
Environmental context and resources	3.03
Behaviour regulation	3.00
Beliefs about consequences	2.49
Reinforcement	2.46

Note. n = 54. See Table 12 for individual items that comprise each scale.

Predictors of BCT use.

Reinforcement. The overall model explained 29.1% of the variance, which was statistically significant, $F(7, 46) = 2.703$, $p = .020$. Inspection of individual predictors revealed that roles other than AEPs were the strongest predictor ($b = -.489$, $p = .002$), indicating that AEPs were less likely to use *reinforcement* related BCTs than other exercise practitioners (i.e., fitness instructors and personal trainers). Socioeconomic advantage explained some of the variance in the model, although it was not statistically significant ($b = -.244$, $p = .062$; see Table 17).

Behaviour regulation. A nonsignificant regression equation was found, $F(7, 46) = 1.687$, $p = .136$ explaining 20.4% of the variance (see Table 18). Age was the only significant predictor variable, with older practitioners using *behaviour regulation* related techniques more regularly than younger practitioners.

Environmental context and resources. A nonsignificant regression equation was found, $F(7, 46) = 1.202$, $p = .320$ explaining 14.1% of the variance (see Table 19). Gender was the only significant predictor variable, with female gender associated with more frequent use of *environmental context and resources* related BCTs.

Beliefs about consequences. A nonsignificant regression equation was found, $F(7, 46) = 2.703$, $p = .020$ explaining 15.5% of the variance (see Table 20). Age was the only significant predictor variable, with older practitioners more likely to use *belief about consequences* techniques.

Table 13. Predictors of Reinforcement BCTs

	B	***p***	**95% CI**
		.000	[6.736, 11.125]
Gender	-.095	.475	[-1.650, .780]
Age	-.049	.785	[-1.762, 1.339]
Employment length	-.082	.610	[-1.661, .986]
AEP	-.489	.002*	[-4.184, -.994]
Postgraduate education	.155	.294	[-.600, 1.938]
Socioeconomic	.244	.062	[-.054, 2.066]
Hospital employment	.071	.625	[-.959, 1.580]
R^2	.291		
F	2.703*		

Note. $n = 54$; *b* = beta standardised coefficient. CI = confidence interval.

*$p < .05$.

Table 14. Predictors of Behaviour Regulation BCTs

	B	***p***	**95% CI**
		.000	[2.212, 4.301]
Gender	.189	.183	[-.190, .967]
Age	-.466	.017*	[-1.650, -.174]
Employment length	.168	.326	[-.319, .940]
AEP	.033	.835	[-.680, -.838]
Postgraduate education	-.096	.537	[-.790, .418]
Socioeconomic	-.052	.705	[-.600, .409]
Hospital employment	.009	.952	[-.586, .622]
R^2	.204		
F	1.687		

Note. n = 54; B = standardised coefficient. CI = confidence interval.

**p < .05.*

Table 15. Predictors of Environmental Context and Resources BCTs

	B	***p***	**95% CI**
		.000	[3.541, 7.106]
Gender	.300	.044*	[.027, 2.001]
Age	.103	.599	[-.928, 1.590]
Employment length	-.273	.127	[-1.906, .244]
AEP	.007	.968	[-1.270, 1.322]
Postgraduate education	.021	.898	[-.965, 1.097]
Socioeconomic	.101	.476	[-.553, 1.169]
Hospital employment	.002	.991	[-1.025, 1.037]
R^2	.141		
F	1.080		

Note. n = 54; b = beta standardised coefficient. CI = confidence interval.

**p < .05.*

Table 16. Predictors of Beliefs about Consequences BCTs

	B	***p***	**95% CI**
		.000	[1.716, 3.755]
Gender	.012	.933	[-.541, .588]
Age	-.386	.050*	[-1.436, .003]
AEP	-.084	.634	[-.468, .761]
Employment length	-.019	.909	[-.783, .699]
Postgraduate education	-.050	.756	[-.681, .498]
Socioeconomic	.241	.091	[-.069, .915]
Hospital employment	.005	.974	[-.580, .599]
R^2	.155		
F	1.203		

Note. n = 54; B = beta standardised coefficient. CI = confidence interval.

**p < .05.*

Summary of main findings. The six most frequently used BCTs were: (1) *T05 Goal setting behaviour*; (2) *T22 Model/demonstrate exercise*; (3) *T13 Provide rewards contingent on successful behaviour*; (4) *T06 Goal setting (outcome)*; (5) *T10 Prompt review of behavioural goals,* and; (6) *T11 Prompt review of outcome goals.* When BCTs were clustered according to their theoretical domains as recommended by Michie et al. (2015) *goals* and *social influences* were the most commonly used groups of BCTs.

Exercise practitioner characteristics predicted the use of *reinforcement* BCTs (i.e., *T13 Provide rewards contingent on behaviour*, *T14 Shaping,* and *T40 Stimulate anticipation of future rewards*). The overall model explained 29.1% of the variance, which was statistically significant, $F(7, 46) = 2.703$, $p = .020$. Inspection of individual predictors revealed that roles other than AEPs predicted the use of reinforcement techniques when promoting exercise participation among people with a chronic disease. Socioeconomic advantage approached statistical significance ($b = .244$, $p = .062$).

While other regression models were not significant, some exercise practitioner characteristics were significantly and independently associated with the use of BCT clusters. Female gender was positively correlated with the use of *environmental and context and resources* ($p < .05$) BCTs. Age was negatively correlated with *behaviour regulation* ($p < .01$) and *beliefs about consequences* ($p < .05$) BCTs.

Chapter 5 will provide a detailed discussion of the main findings of the quantitative study and bring together the results from Study 1 and Study 2 for comparison. The findings of this quantitative study are discussed in relation to the previous empirical evidence. The limitations of this quantitative research will also be discussed. Practical implications of this

research will be provided, including implications for clinical practice, education and training, implementation of exercise interventions in research, and strategies for the promotion of exercise among people with a chronic disease, particularly T2DM.

Chapter 5: General Discussion

Chapter Introduction

In this chapter, the qualitative results from Study 1 and quantitative results from Study 2 are brought together for comparison. The chapter begins with an overview of each study before the findings from both studies are compared and contrasted with previous research. The contribution of the results to the body of knowledge is presented, and practical implications are provided for research, clinical practice, and education and training. The chapter concludes with a description of the strengths and limitations of the studies and recommendations for future research.

Overview of Study 1. Study 1 was a qualitative study, which examined the uptake and maintenance of exercise in people with T2DM. People with T2DM reported themes consistent with nine TDF domains: (1) *reinforcement*; (2) *behaviour regulation*; (3) *beliefs about consequences*; (4) *social influences*; (5) *emotion*; (6) *beliefs about capabilities*; (7) *environmental context and resources*; (8) *social/professional role and identity,* and; (9) *goals*. The following section provides an examination of the domains and how they may overlap and work synergistically to facilitate the uptake and maintenance of exercise among people with T2DM.

Overview of Study 2. Study 2 was a quantitative study of the BCTs used by exercise practitioners in clinical practice when working with clients with a chronic disease. Selected BCTs from the CALO-RE taxonomy were clustered into theoretically similar groups aligning with domains of the TDF (Cane et al., 2012; Michie et al., 2015). Six groups of BCTs were analysed: (1) *goals*; (2) *social influences*; (3) *environmental context and resources*; (4) *behaviour regulation*; (5) *reinforcement,* and; (6) *beliefs about consequences*. These TDF

domains were related to exercise uptake and maintenance among people with T2DM reported in Study 1. The use of theory-based BCTs by exercise practitioners will be compared to the perspectives of the individuals with T2DM in Study 1. Practical implications for improving the effectiveness of exercise interventions to increase participation among people with a chronic disease are provided.

Use of Behaviour Change Strategies by People with T2DM

Reinforcement and beliefs about consequences. The findings of this study were consistent with previous studies demonstrating that *reinforcement* and *beliefs about consequences* are crucial for exercise uptake and maintenance among people with a chronic disease (Sweet et al., 2019). People with T2DM described how the beliefs about the health consequences of exercise and noticing and valuing these desired health benefits are essential to attending a supervised exercise intervention and maintaining exercise participation after the trial. Similar results have also been found for people at risk of T2DM and those with CVD (Penn et al., 2013; Sweet et al., 2019). The findings extend on previous research by highlighting the value of immediate physiological improvements, such as improved blood glucose control, at the initiation of exercise by people with T2DM. People with T2DM believed these immediate health outcomes were a direct consequence of their exercise participation. Therefore, by valuing these outcomes and noticing these changes during exercise sessions, people were reinforced for their efforts. At the initiation of exercise, exercise practitioners should seek to understand and clarify the client's beliefs about the consequences of exercise. The findings suggest that information collected for outcome data or for safety measures may be an intervention in and of itself. Clients with T2DM should bring their glucose monitoring equipment to exercise sessions to bring clients attention to their pre- and post-exercise blood glucose readings. During exercise sessions, exercise

practitioners can direct the client's attention to the immediate consequences of exercise, such as decreases in blood glucose levels, to provide an immediate reinforcement. Focusing on long-term changes, such as reductions in HbA1c, which require months of sustained exercise, might be more appropriate in the maintenance phase. *Reinforcement* strategies may include providing praise and encouragement for the achievement or attempts at achieving exercise (Cane et al., 2012). Incorporating *beliefs about consequences* strategies may include directing a person's attention to consider how they will feel if they do or do not participate in exercise (Cane et al., 2012). Researchers attempting to increase exercise participation among people with T2DM should use behaviour change strategies that incorporate *beliefs about consequences* and *reinforcement* TDF domains within their planned interventions.

Behaviour regulation. *Behaviour regulation* was essential for exercise maintenance among people with T2DM. The finding is consistent with qualitative research of people with and at risk of chronic disease following participation in a supervised exercise intervention (Penn et al., 2013; Sweet et al., 2019). Similarly, to people with prediabetes and CVD, individuals with T2DM described behaviour regulation strategies such as habit, routines, and prioritising exercise around other commitments. Additionally, people with T2DM reported self-monitoring as an important strategy to maintain their exercise participation. For example, monitoring of the health outcomes of exercise such as HbA1c, blood pressure, cholesterol, and body weight. Habit and self-monitoring are associated with the self-management of chronic diseases more broadly (Bodenheimer, Lorig, Holman, & Grumbach, 2002). Chronic disease self-management refers to the active involvement of people in daily self-care behaviours required to manage their chronic disease (Jordan & Osborne, 2007). People with effective self-management skills – such as habit, action planning, and self-monitoring – have enhanced healthcare behaviours such as exercise participation, blood glucose monitoring,

medication adherence, and healthy eating (Jordan & Osborne, 2007). Enhanced self-care behaviours leads to better clinical outcomes for people with T2DM (ADA, 2019). Exercise practitioners can help people with T2DM by providing self-management education and teaching of skills to facilitate exercise participation at all stages of T2DM. Self-management skills may include strategies such as keeping a record of exercise (i.e., mode, frequency, duration, intensity) and of the desired health outcomes such as improved HbA1c, blood pressure, cholesterol, and mood (Cane et al., 2012). Exercise practitioners should monitor their client's performance of behaviour regulation strategies and the barriers hindering the person's ability to self-manage as part of routine clinical care (ADA, 2019). Exercise practitioners can consult with other members of the multidisciplinary team to provide information about self-care barriers and facilitators for exercise and how these may relate to other aspects of self-care for T2DM management (e.g., medication adherence, glucose monitoring, and diet). Researchers investigating exercise participation for T2DM management should be mindful to select *behaviour regulation* strategies, including habit, self-monitoring of exercise, and self-monitoring of health outcomes related specifically to T2DM influenced by exercise.

Beliefs about capabilities. The findings are consistent with previous studies showing that *beliefs about capabilities* was related to exercise uptake and maintenance among people with and at risk of a chronic disease (Penn et al., 2013; Sweet et al., 2019). The supervised exercise sessions provided individuals with T2DM an opportunity to safely exercise in the context of diabetes. The perception of safety is crucial for people with T2DM who typically encounter disease-specific concerns about their ability to initiate exercise safely due to hypoglycaemia, poor blood circulation, monitoring of foot care, and concerns regarding overweight and obesity (ADA, 2019). Individuals with T2DM described how they to build

their self-efficacy and self-confidence slowly through their engagement in the exercise sessions. As self-efficacy and self-confidence levels increased during the efficacy trial people felt increasingly confident in their ability to try new, more intense exercise, and exercise independently after the trial. Similar findings have been found for adults at risk of T2DM and for people with CVD attending a supervised exercise rehabilitation program (Penn et al., 2013; Sweet et al., 2019). The findings of this study provide further evidence for *beliefs about capabilities* as crucial for the uptake and maintenance of exercise among people with T2DM.

Social influences. Findings of this research build on previous studies demonstrating the role of the therapeutic alliance in exercise behaviour change (Hall, Ferreira, Maher, Latimer, & Ferreira, 2010; Moore, Holden, Foster, & Jinks, 2020; Stødle Vestøl, Debesay, Pajalic, & Bergland, 2020). People with T2DM described the importance of the therapeutic alliance in their exercise engagement regardless of being in the intervention or control group. Similar results have been found among people with osteoarthritis (Moore et al., 2020). Individuals with T2DM reported a therapeutic alliance that fostered a feeling of mutuality, respect, and trust as important to their exercise uptake and maintenance. Similar findings have been reported as relevant to exercise maintenance following hip surgery (Stødle Vestøl et al., 2020). Exercise practitioners should consider how the therapeutic alliance can influence the behaviour of their clients to engage in exercise. Developing a positive therapeutic relationship may increase exercise uptake and maintenance among clients with T2DM.

The participants' relationship with research staff encouraged and reinforced their behaviour change. This finding highlights the importance of the therapeutic alliance in the success of efficacy trials. Often the relationships between the research team and participants

are not considered as a vital component of exercise trials. The findings of this study have important implications for efficacy trials as the therapeutic alliance appears to be a significant nonspecific treatment effect. Exercise researchers may need to control for the impact of the therapeutic alliance by measuring the therapeutic alliance using instruments such as the Working Alliance Inventory (Elvins & Green, 2008).

Emotion. Positive experiences of the exercise sessions facilitated engagement in people with T2DM. Affect can facilitate and hinder exercise behaviour change among people with mental illness (Glowacki et al., 2017) and those with a physical disease (Cox et al., 2017; Nicholson et al., 2014; Sweet et al., 2019). The affective experience people associate with exercise has been described as a critical factor to future exercise participation in the affective-reflective theory of physical inactivity and exercise (Brand & Ekkekakis, 2018). Exercise practitioners should work with their clients to create positive experiences during exercise sessions. Positive experiences can be achieved by considering the client's exercise likes, dislikes, and preferences in the prescription of exercise mode and intensity. Self-report measures of affect can be used to measure client enjoyment during exercise sessions. Such measures include the Feelings Scale (Boutcher, McAuley, & Courneya, 1997), Physical Activity Enjoyment Scale (Kendzierski & DeCarlo, 1991), and the Positive and Negative Affect Schedule (Boutcher et al., 1997). Exercise researchers should select behaviour change theories and frameworks that incorporate the *emotion* theoretical domain and associated constructs when designing exercise interventions for people with T2DM (Cox, Keating, Coombes, & Burton, 2019). Affect should be included as an important outcome measure in future exercise research.

People with T2DM are particularly vulnerable to affective disorders such as depression and anxiety (Grigsby, Anderson, Freedland, Clouse, & Lustman, 2002; Mezuk,

Eaton, Albrecht, & Golden, 2008; Roy & Lloyd, 2012; Rubin et al., 2008). Exercise practitioners should consider the presence of comorbid affective disorders particularly because symptoms of affective disorders may make it difficult for people with T2DM to adhere to exercise (Gonzalez et al., 2008). Exercise practitioners are increasingly becoming involved as part of multidisciplinary teams in mental health and can work collaboratively with other practitioners to ensure consistency in care planning (Lederman et al., 2016; Stanton, 2013). Further, addressing T2DM and depression at the same time results in improved outcomes for both chronic diseases (Atlantis, Fahey, & Foster, 2014). Therefore, AEPs can assist other practitioners involved in a consumer's care to understand the role of exercise and in the strategies that are effective for that individual. Behaviour change strategies that are effective for may be valuable for other health behaviours being addressed by other practitioners (e.g., diet, sleep, alcohol intake, and smoking cessation).

Environmental context and resources. The findings of the present research are consistent with previous work demonstrating how *environmental context and resources* can facilitate and hinder exercise participation (Penn et al., 2013). People with T2DM described financial barriers to exercise participation as an incentive to engage in the exercise sessions and volunteer for AEP students. Similar findings have been found among people at risk of T2DM participating in an exercise intervention in a socioeconomically disadvantaged area of London (Penn et al., 2013). Given that socioeconomic status is a determinant of health (AIHW, 2018a) and exercise participation (Bennie et al., 2015), effective exercise prescription must account for the factors in a person's environment that facilitate and hinder exercise participation. Low or no-cost options for exercise (i.e., walking and home exercise programs), proximity of exercise sessions to home, and flexibility of exercise times (to fit around work and family commitments) should be considered. Additionally, when prescribing

exercise for people with T2DM the location in which the exercise is recommended should be perceived as safe by the person with T2DM, particularly at the initiation of exercise (e.g., supervised versus unsupervised exercise, outdoor versus indoor exercise).

Participants with T2DM reported that volunteering for student exercise practitioners helped them to maintain their exercise participation after they participated in the efficacy trial. Previous research has shown that interventions delivered by students provide benefits to the community and students. For example, student-run probono physical therapy clinics demonstrated significant changes in outcomes among socioeconomically disadvantaged patients while students were able to expand their clinical experience simultaneously (Stickler et al., 2016). Probono or low-cost interventions provided by student exercise practitioners may be a valuable way to provide exercise services to people with T2DM and facilitating initiation and maintenance of exercise. Formal evaluation of student-led exercise clinics would determine their safety, clinical effectiveness, and ability to improve exercise behaviour change among socioeconomically disadvantaged groups such as those with T2DM.

Exercise researchers should be mindful of how to support research participants to maintain their exercise participation after the conclusion of an efficacy trial. Research involving human participants must be ethically conducted, as outlined by the declaration of Helsinki (World Medical Association, 2013). Basic principles of the declaration include prioritising the health and safety of participants above all other interests (Harriss, MacSween, & Atkinson, 2019); therefore, ethical practice takes precedence over scientific interests or considerations. The cessation of exercise is associated with adverse health outcomes (Esain, Gil, Bidaurrazaga-Letona, & Rodriguez-Larrad, 2019), and researchers may have an ethical obligation to support the ongoing exercise participation of participants. Researchers should

consider providing research participants with referrals to appropriate community services, recommendations for local exercise options, and home exercise programs.

Social/professional role and identity. People with T2DM described personality characteristics that influenced their exercise behaviour change. Individuals with T2DM described feeling a sense of duty to volunteer for exercise sessions which facilitated the uptake and maintenance of exercise. The findings are consistent with broader literature suggesting that clinical research participants are characteristically different from people who do not volunteer for research (Lönnqvist, Verkasalo, & Bezmenova, 2007; Rosenthal & Rosnow, 1975). Additionally, adults who volunteer for exercise studies may be fitter and healthier than people who are not inclined to participate (de Souto Barreto, Ferrandez, & Saliba-Serre, 2013). Exercise researchers should be aware of volunteer bias as it suggests that participants have different personality and health characteristics from the general population of interest (i.e., people without T2DM). Volunteer bias limits the generalisability of research conclusions to the less empowered and less motivated people with T2DM.

Goals. The findings are consistent with previous research suggesting that the *goals* domain was relevant to the uptake and maintenance of exercise (Penn et al., 2013; Sweet et al., 2019). Participants with T2DM described engaging in the exercise sessions to achieve health-related goals they had set for themselves regardless of the research intervention priorities and outcomes. Similar results have been found among people at risk of T2DM who joined an exercise behaviour change intervention with pre-determined health-related goals rather than goals based on exercise behaviour (Penn et al., 2013). The results support the notion that people with T2DM place more value on the health-related outcomes of exercise compared to individuals without a chronic disease (Williams & Bond, 2002). Exercise practitioners can help facilitate exercise uptake and maintenance by assisting clients with

formulating health-related outcome goals that are meaningful to the client and in the context of their T2DM . Exercise practitioners should also acknowledge and respect that client goals may differ from practitioner goals and priorities and prescribe exercise accordingly.

Exercise Practitioner use of Theory-informed BCTs in Practice

Exercise practitioners most frequently used BCTs related to the goals TDF domain which is consistent with the dominance of cognitive-based behaviour change theories in the exercise literature (Rhodes et al., 2018). Social influences were the second most routinely used BCTs. Less frequently used BCTs were related to *behaviour regulation*, *reinforcement*, and *beliefs about consequences* domains.

Goals and social influences. Exercise practitioners almost always encouraged clients to set goals about exercise behaviour and exercise outcomes and review these goals. BCTs that encourage individuals to set and review goals have been associated with increased exercise behaviour in healthy people (Michie, Abraham, et al., 2009) and improved health outcomes, such as reduced HbA1c and body mass index, among people with T2DM (Avery et al., 2015; Cradock et al., 2017; Hankonen et al., 2014). The frequent use of goal-related BCTs was expected because the scope of practice for the AEP and fitness professional makes specific reference to the use of goal-setting behaviour change strategies when promoting exercise participation among clients (ESSA, 2015b; Fitness Australia, 2019). The results of from studies 1 and 2 suggest that exercise practitioners should continue to use goal-related BCTs in practice, however, assisting clients to formulate health-related outcome goals may be more effective than behaviour-related goals to promote exercise uptake and maintenance among people with a chronic disease, particularly those with T2DM.

Exercise practitioners almost always showed their clients how to perform exercises by providing physical and visual demonstrations and such *social influences* related BCTs have

been shown to be beneficial for people with a chronic disease. Systematic reviews of people with T2DM have shown that such BCTs were associated with reductions in HbA1c and body mass index (Cradock et al., 2017; Hankonen et al., 2014). People with T2DM in Study 1 reported that support provided by research staff was crucial to their exercise participation. Therefore, rather than merely demonstrating exercises, facilitating social support through the therapeutic alliance may be particularly beneficial to increase exercise participation among people with T2DM .

Exercise practitioners rarely encouraged clients to make comparisons with other people as a behaviour change strategy in clinical practice. People with T2DM in Study 1 reported that social comparison to others with T2DM, overweight/obese, and of a similar age increased their self-efficacy and self-confidence to exercise. Expanding the exercise practitioners' repertoire of BCTs related to *social influences* – such as facilitating social comparison – may promote exercise participation among people with T2DM .

Behaviour regulation, reinforcement, and beliefs about consequences.

Encouraging clients to keep a record of their exercise was the least commonly used BCT by exercise practitioners in clinical practice. Systematic reviews have found *behaviour regulation* techniques, such self-monitoring, to be an essential strategy for exercise participation among apparently healthy and at risk populations (Michie, Abraham, et al., 2009; Olander et al., 2013). Self-monitoring of exercise outcomes, such as blood glucose levels, was identified as an important behaviour change strategy by people with T2DM in Study 1. *Behaviour regulation* skills are fundamental for effective self-management of people with a chronic disease and exercise practitioners are well placed on teaching these skills to their clients (Bodenheimer et al., 2002). However, teaching self-management skills is dependent on practitioner knowledge and skills about these strategies (Jordan & Osborne,

2007). Therefore, it is recommended that exercise practitioners receive formal education on the role of *behaviour regulation* in exercise participation for T2DM management. For example, existing self-management education protocols endorsed by the ADA (2019) can be incorporated into the exercise physiology curriculum.

Reinforcement is related to automatic motivation, a relatively new concept that broadens the understanding of motivation beyond reflective motivation which has dominated in the exercise literature (Michie, Johnston, Abraham, et al., 2005). Exercise practitioners frequently provided praise and encouragement if a client reaches their exercise goal. However, exercise practitioners less frequently used other *reinforcement* techniques, such as focusing on immediate rewards during exercise, for example, improved glucose control and enhanced mood.

All individuals with T2DM in Study 1 reported factors consistent with *reinforcement*, *beliefs about consequences*, and *behaviour regulation* domains, demonstrating the importance of awareness of exercise on desired health outcomes for exercise behaviour change. The findings have important practical implications for exercise practitioners. For example, what might be used as research outcome data or safety information in clinical practice, may be an intervention in and of itself.

BCTs related to *goals* and *social influences* are also the most frequently used by exercise practitioners in clinical practice. The exercise physiology professional standards, used by universities to assist in the design of curriculum, refers to use of behaviour change strategies such as goal setting and social support (ESSA, 2015a). The professional standards do not refer to *reinforcement*, *beliefs about consequences*, or *behaviour regulation* techniques (ESSA, 2015a). Exercise practitioners may not use these BCTs because they do not receive education and training in their use. An evidence-based curriculum should incorporate up to

date research from the behaviour change literature and the emerging evidence in exercise and behaviour change science. Additionally, having clinical researchers and exercise practitioners involved in teaching can add address the gap between research and clinical practice.

Factors Associated with Exercise Practitioner use of BCTs

Female gender was positively associated with the use of *environmental context and resources* related BCTs. Female exercise practitioners are more likely to encourage their clients to change their environment to facilitate exercise behaviour compared to male exercise practitioners. Research has identified differences in practice between male and female physicians in delivering chronic disease care (Baumhakel, Muller, & Bohm, 2009; Berthold, Gouni-Berthold, Bestehorn, Böhm, & Krone, 2008; Kim et al., 2005). Female physicians have been found to provide more psychosocial counselling and active listening to clients compared to male practitioners (Roter et al., 2002). Female exercise practitioners may adopt similar communication styles with clients that enable them to use techniques that to address environmental factors that influence exercise behaviour in clients' everyday lives.

Practitioners aged 35 and over were more likely to encourage their clients to self-monitor exercise and prompt clients to think about the consequences of not performing exercise. Older exercise practitioners may spend more time than younger practitioners engaging in active listening, allowing them to pick up on client cues regarding their exercise beliefs, attitudes, and self-management skills. Similar findings have been found among physical therapists. Older physical therapists have been found to spend more session time dedicated to identifying the client's concerns and finding helpful ways a client can overcome their problem (Jensen, Gwyer, & Shepard, 2000). Whereas younger practitioners spent more time working on the mechanical aspects of treatment, for example, objective assessments and exercise technique (Jensen et al., 2000).

AEPs are less likely than fitness instructors and personal trainers to use *reinforcement* related BCTs. Clients tend to see fitness instructors and personal trainers regularly (Fitness Australia, 2016), and this ongoing relationship likely facilitates the use of *reinforcement* techniques. AEPs see many clients through publicly funded schemes (i.e., Chronic Disease Management Plan; Deloitte Access Economics, 2015) and evidence suggests that clients access between two and three sessions through such programs (Craike, Wiesner, Enticott, Bennie, & Biddle, 2018). Therefore, there is less likely to be an ongoing relationship between AEPs and their clients, precluding the use of *reinforcement strategies*. This finding suggests that BCTs used by exercise practitioners are possibly influenced by the settings in which they practice and the extent to which these settings facilitate ongoing interactions with clients.

Another explanation for the relatively low use of *reinforcement* strategies by AEPs relates to the importance of intrinsic motivation. Intrinsic motivation is a strong predictor of long-term exercise participation (Fortier, Sweet, O'Sullivan, & Williams, 2007). AEPs may believe the use of *reinforcement* related BCTs undermines the development of intrinsic motivation (Deci, Koestner, & Ryan, 1999). Although some researchers suggest that reinforcement might reduce intrinsic motivation, there is no empirical evidence to support this. For example, a systematic review of randomised controlled trials using incentive procedures to promote exercise behaviour found that no study included a measure of motivation to determine if the intrinsic motivation was impacted (Strohacker, Galarraga, & Williams, 2014). Research on the effect of reinforcement techniques and intrinsic motivation is warranted.

Contribution to Knowledge

To the author's knowledge, this study is the first to use the TDF to identify the factors related to exercise participation in people with T2DM. The TDF captured a wide range of

personal and environmental contextual influences that were related to exercise behaviour change at initiation and maintenance phases. The range of themes that emerged from the data is consistent with the proposition that a single theory alone (e.g., self-efficacy theory and theory of planned behaviour) cannot explain the behaviour change process. This study adds to the literature by applying the TDF to understand the uptake and maintenance of exercise among people with T2DM, which has implications for designing future intervention studies and current clinical practice.

The findings of the study added to emerging literature about the importance of *emotion* as a significant predictor of exercise. Themes related to exercise participation among people with a chronic disease, such as the *emotion* TDF domain, have been, until recently, mainly neglected in traditional theories of behaviour change in exercise literature (Brand & Ekkekakis, 2018). BCTs related to the *emotion* domain are currently not listed in the CALO-RE taxonomy. However, the results highlight the importance of BCTs related to the *emotion* domain in exercise behaviour change among people with T2DM. For example, including information about emotional consequences and monitoring of emotional effects of exercise may be useful in promoting exercise behaviour change (Michie et al., 2015).

To the author's knowledge, this is the first study to examine exercise practitioners' use of BCTs in clinical practice. Exercise practitioners use theory-based BCTs related to the *beliefs about consequences*, *reinforcement*, and *behaviour regulation* TDF domains less frequently than other techniques such as *goals* and *social influences*. To date, there has been no measure to assess the BCTs used by exercise practitioners comprehensively. This study included the development of the BCI-EP for this purpose. The BCI-EP can be used for a range of research purposes to examine the relationship between the use of BCTs and exercise uptake and maintenance in practice. The BCI-EP can also be used among other practitioners

to assess and monitor their use of BCTs in the initiation and maintenance of exercise among clinical and nonclinical populations.

The perspectives of individuals with T2DM through an exercise efficacy trial has rarely been examined. Therefore, this study contributes to the literature by highlighting the behaviour change process during an efficacy trial as a way of better understanding exercise behaviour while underscoring the responsibilities of researchers in such trials. The therapeutic alliance appears to be a nonspecific treatment effect that should be measured and controlled for in efficacy trials (e.g., use of the Working Alliance Inventory). Exercise researchers should also be mindful of supporting participants to maintain their exercise participation after the conclusion of the trial. Study 1 was not designed as a behaviour change intervention (ul Haq et al., 2014). However, this research highlights the importance of identifying BCTs used in intervention design even during an exercise efficacy trial focused on health and clinical effects (Courneya, 2010). For example, individuals with T2DM are typically required to be physically inactive before entry into interventions that examine the health and clinical outcomes of an exercise intervention for the interventions' effect to be evaluated (Courneya, 2010). As such, many clinical trials include techniques to ensure participant adherence to the intervention during the intervention period (Courneya, 2010) and participation has shown to drop-off after an intervention (Dunstan et al., 2005). As exercise research studies often suffer from high dropout rates, research teams employ techniques to maximise adherence to interventions (Courneya, 2010). The results of the study suggest that behaviour change occurs even though it may not be the intended purpose of an exercise trial. While researchers focus on assessing health and other effects, individuals with T2DM may see this as an opportunity to integrate exercise into their lives (Courneya, 2010). Understanding the behaviour change process of individuals with T2DM through an efficacy

trial may provide insights as to why behaviour change trials in real-life scenarios fail to produce the same level of behavioural and clinical outcomes (Hagger & Weed, 2019).

Strengths and Limitations

Strengths and limitations of Study 1. Strengths included the use of the TDF to examine the perspectives of people with T2DM through qualitative methods. Deductive thematic analysis using the TDF provided a robust and theoretically driven framework to explore the facilitators and barriers to exercise (Cane et al., 2012). Thematic analysis focuses on patterns or themes in a data set and differs from other qualitative methods, such as interpretive phenomenological analysis, which focuses on the individual. Therefore, thematic analysis is an appropriate qualitative method to capture theoretical domains that are relevant to people with T2DM. Open-ended dialogue ensured that the interviews were guided by the individuals with T2DM, rather than the researcher, to elicit rich and descriptive data. The use of semistructured interviews encouraged the individuals with T2DM to tell their own stories in a way that emphasised factors that were important to them. The interviews allowed the exercise intervention to be contextualised into the person's broader life and management of their chronic disease. The author knew the participants with T2DM and had already established a good rapport with them, providing a safe environment for participants to tell their stories. As the interviews were conducted in the research gym, it was convenient and familiar to the individuals with T2DM from the efficacy trial. Interviews are more appropriate than focus groups, as specific individuals may have influenced the thoughts and ideas of others (Leung & Savithiri, 2009).

There are limitations to the qualitative study, however. Limitations include secondary data analysis, the potential for recall and researcher bias, and the small sample number. A disadvantage of secondary data analysis is the potential for missed opportunities for probing

during the interviews. Therefore, some TDF domains may not have been reported because the researcher did not explicitly prompt them (Tripathy, 2013). Future research would benefit from an interview schedule explicitly exploring BCT use by participants.

The student researcher had an existing prior relationship with the participants from recruitment through to completion from the efficacy trial. The student researcher was involved in the data collection and delivery of the intervention and active control group exercise programs. Therefore, the student researcher was invested in the participants' outcomes and wanted them to do well. Participants also described the relationship with research staff as encouraging and reinforcing to their behaviour change. This finding highlights the influence of interpersonal relationships on the qualitative interview data. Researcher bias may have influenced the nonverbal interaction and desire of participants to please the student researcher (Lönnqvist et al., 2007; McCrae & Costa, 1992; Rosenthal & Rosnow, 1975). The potential for researcher bias was reduced by practising reflexivity, and having two researchers not involved in the efficacy trial code some of the transcripts independently (Greenbank, 2003; Lincoln & Denzin, 2003).

Qualitative research is vulnerable to recall bias. The interviews were conducted 12 to 18 months after the conclusion of participation in the intervention, which may have led to participant recall bias. Although this did provide an opportunity for examination of longer-term behaviour change which is rarely reported in research studies (Adams & White, 2003; Dishman, 1988; van der Bij, Laurant, & Wensing, 2002). Ideally, individuals with T2DM would be interviewed after the intervention and then again at 12 months follow-up. Another limitation relates to the low number of participants included in the study. The small sample size was a limitation based on resources including time and the initial extensive efficacy trial, which involved a substantial time commitment and long waiting times for baseline testing to

be completed. Additionally, five individuals with T2DM who completed the efficacy trial volunteered to participate in the interview making the study vulnerable to selection bias. Furthermore, data saturation was not able to be achieved due to the study design.

Strengths and limitations of Study 2. Strengths related to the development of the BCI-EP to measure BCTs used by exercise practitioners and grouping of BCTs by theory. The BCI-EP was developed to measure the use of BCTs in practice, based on a reliable and standardised taxonomy, thereby creating an essential first step in understanding the BCTs used in practice. The questionnaire was pilot tested and designed specifically for use with exercise practitioners. Because using the full 40 BCT items in the statistical analysis would require considerable power it was appropriate to analyse clusters of conceptually coherent BCTs (i.e., TDF domains) according to the research question as suggested by the developers of the CALO-RE taxonomy (Michie et al., 2011). The TDF domains were created with good reliability and validity and designed based on a collection of empirical evidence (Michie et al., 2011).

Limitations of Study 2 included the questionnaire design, positively skewed data and small sample size, and an overrepresentation of female exercise practitioners in the sample. The use of the Likert-type questions to measure the frequency of BCT use may have contributed to the negatively skewed distribution of values due to observer effects such as social desirability and acquiescence bias (Krosnick, 1999). The skewness of responses to the right and can contribute to a ceiling effect (Howitt & Cramer, 2005). In addition to the small sample size and weak bivariate correlations, caution must be applied when interpreting and generalising the results.

Future Research Directions

Further qualitative research should validate the theoretical domains identified as relevant for the uptake and maintenance of exercise among people with T2DM using the interview questions developed by Cane et al. (2012). Future qualitative studies should also use the TDF to explore the experiences of individuals with T2DM who were unsuccessful in the initiation of exercise. Researchers should assess the use of BCTs by participants in exercise trials, to determine the association between the BCTs used and behaviour change (rather than relying on BCTs reported as part of intervention delivery). Quantitative research should also examine the differences in uptake and maintenance and use these relevant TDF domains in the design of interventions. For example, the TDF could be used to predict which individuals would require more extended support to ensure behaviour change is maintained following an intensive intervention period.

The BCI-EP can be used in future research to assess the use of BCTs in different clinical and practice settings. The BCI-EP can also be used to measure other practitioners use of BCT in the initiation and maintenance of exercise among clinical populations. Further, the BCI-EP could be used to assess the relationship between exercise practitioner use of BCTs and client exercise uptake and maintenance in clinical practice.

Future research should consider the use of alternative data collection methods to reduce the likelihood of responder bias to self-report Likert scale questionnaires. The measurement of exercise practitioner behaviour in different context may require a more multidimensional approach than Likert-type scales offer. Observation of clinical practice and the use of clinical vignettes may provide more useful information about practitioner behaviour (Evans et al., 2015). For example, a vignette is a brief description of a person or situation designed to simulate key features of a real-world scenario (Atzmüller & Steiner, 2010). Clinical vignettes could be used to accurately measure in what circumstances exercise

practitioners use BCTs and what factors influence their decisions, beyond demographic characteristics.

Proposed Post-Doctoral Study

To build on the results of this thesis, further research to measure the effectiveness of the identified BCTs in improving exercise uptake and adherence is needed. For example, the BCTs identified in this thesis (e.g., reinforcement and behaviour regulation) could be applied within an intervention to assess their effectiveness on exercise initiation and maintenance in real-world settings. A proposed design and protocol for a post-doctoral study is outlined below.

Aim. The aims of the proposed study are: (1) to assess the effectiveness of a behaviour change intervention on physical activity initiation, maintenance and a range of clinical outcomes in primary care settings, and; (2) to evaluate the fidelity of behaviour change intervention by exercise practitioners in primary care settings.

Hypothesis. The behaviour change intervention will improve: (1) initiation of physical activity behaviour at three months; (2) maintenance of physical activity behaviour at six and 12 months and; (3) glycemic control at six and 12 months compared to usual care. Greater fidelity of behaviour change intervention by AEPs will be associated with increased physical activity behaviour and improved clinical outcomes.

Design. A hybrid effectiveness-implementation design with be adopted for the simultaneous assessment of effectiveness (focusing on behaviour change, along with a range of clinical outcomes in primary care settings) and implementation (program fidelity by exercise practitioners) of a behaviour change intervention (Curran, Bauer, Mittlman, Pyne, & Stetler, 2012).

Setting and Participants. AEPs who deliver group diabetes services under Medicare in primary care settings (and their clients) will be invited to participate in the study.

Intervention. AEPs randomised to the intervention group will receive training in the delivery of a theory-based behaviour change intervention to be delivered in nine Medicare funded sessions (one assessment plus eight group sessions). The behaviour change intervention consists of theory-based BCTs identified by participants in Study 1 as helpful for the initiation and maintenance of physical activity (e.g., self-monitoring, reinforcement, incentive, and social comparison). AEPs randomised to the control group do not receive any training in the behaviour change intervention and participants attend nine Medicare funded groups (i.e., usual care).

Main Outcome Measures. At baseline, end of group sessions and six and 12 months following completion of the conclusion of nine sessions: client use of BCTs by self-administered questionnaire; subjective and objective physical activity; clinical outcomes (e.g., glycemic control, waist circumference, and quality of life), and; AEP treatment fidelity.

Data Analysis. The effectiveness of the intervention will be assessed by comparing the differences between the control and intervention groups. To assess the role of BCTs in the behaviour change process a mediation analysis will be performed, with client use of BCTs as the mediators, to show which BCTs were associated with outcomes. Further, implementation fidelity by exercise practitioners will be analysed using descriptive statistics.

Conclusion

People with T2DM reported the following theoretical domains as related to their exercise behaviour change: (1) *reinforcement*; (2) *behaviour regulation*; (3) *beliefs about consequences*; (4) *social influences*; (5) *emotion*; (6) *beliefs about capabilities*; (7) *environmental context and resources*; (8) *social/professional role and identity*, and; (9) *goals*.

The findings add to the literature by highlighting *emotion* as a crucial theoretical domain in exercise initiation and maintenance among people with T2DM . *Emotion* related BCTs could be added to existing taxonomies such as the CALO-RE to expand existing knowledge of exercise participation to improve T2DM management. *Behaviour regulation* is crucial to the maintenance of exercise for the treatment of chronic disease. Exercise practitioners use BCTs related to *goals* and *social influences* theoretical domains when working with people with a chronic disease and previous studies have shown these techniques are associated with increased exercise behaviour and clinical outcomes among people with a chronic disease. Some exercise practitioner characteristics were associated with the use of BCTs. For example, female exercise practitioners were more likely to use *environmental context and resources* compared to male practitioners, and older practitioners were more likely to use *behaviour regulation* and *beliefs about consequences* BCTs compared to younger practitioners. AEPs were less likely to use *reinforcement* related BCTs compared to fitness instructors and personal trainers. The results can be used by exercise practitioners to help select effective BCTs when prescribing exercise programs for people with T2DM .

People with T2DM may prioritise and prefer different behaviour change strategies compared to techniques used by exercise practitioners in practice. Therefore, exercise practitioners should actively engage their clients in their behaviour change to optimise evidence-based practice for T2DM management. The results can inform the training and education of exercise practitioners to improve their knowledge and skills in the application of *reinforcement, beliefs about consequences,* and *behaviour regulation* BCTs for exercise initiation and maintenance for T2DM management. There is a need for engagement with key industry partners, universities, and professional associations (such as ESSA and Fitness

Australia) to provide a means of training and continuing professional development for the standard application of effective BCTs in clinical settings.

The BCI-EP can be used in future research to examine the relationship between the use of BCTs in practice and client exercise maintenance. The BCI-EP can also be used to assess other practitioner use of BCTs in exercise promotion among clinical and nonclinical populations.

A range of cognitive, affective, social, and environmental theoretical domains are related to exercise behaviour change among people with T2DM . These theoretical domains must be integrated and applied in the development of exercise interventions and programs in research and clinical practice to improve the knowledge base and effectiveness of exercise prescription for people with T2DM . Insufficient exercise is the fourth leading cause of death worldwide and costs the healthcare system billions of dollars each year. Therefore, optimising the success for people with T2DM to engage in exercise and continue their participation long-term will have significant individual and public health benefits.

References

Abraham, C., & Michie, S. (2008). A taxonomy of behavior change techniques used in interventions. *Health Psychology, 27*(3), 379-387. doi:10.1037/0278-6133.27.3.379

Adams, J., & White, M. (2003). Are activity promotion interventions based on the transtheoretical model effective? A critical review. *British Journal of Sports Medicine, 37*(2), 106-114.

Agurs-Collins, T. D., Kumanyika, S. K., Ten Have, T. R., & Adams-Campbell, L. L. (1997). A randomized controlled trial of weight reduction and exercise for diabetes management in older African-American subjects. *Diabetes Care, 20*(10), 1503-1511. doi:10.2337/diacare.20.10.1503

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211.

Alberti, K. (1996). The clinical implications of impaired glucose tolerance. *Diabetic Medicine, 13*(11), 927-937.

Alberti, K., Eckel, R. H., Grundy, S. M., Zimmet, P. Z., Cleeman, J. I., Donato, K. A., & Smith, S. C. (2009). Harmonizing the metabolic syndrome: A joint interim statement of the International Diabetes Federation task force on epidemiology and prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. *Circulation, 120*(16), 1640-1645.

American College of Sports Medicine. (2014). *Resource manual for guidelines for exercise testing and prescription* (7 ed.). Philadelphia: Wolters Kluwer Health.

American Diabetes Association. (2014). Standards of medical care in diabetes. *Diabetes Care, 37,* S14-S80.

American Diabetes Association. (2019). Lifestyle management: Standards of medical care in diabetes 2019. *Diabetes Care, 42*(Supplement 1), S46-S60.

Apelqvist, J., Bakker, K., Van Houtum, W. H., & Schaper, N. C. (2008). Practical guidelines on the management and prevention of the diabetic foot: Based upon the international consensus on the diabetic foot 2007. *Diabetes/Metabolism Research and Reviews, 24*. doi:10.1002/dmrr.848

Atkins, L., Francis, J., Islam, R., O'Connor, D., Patey, A., Ivers, N., . . . Grimshaw, J. M. (2017). A guide to using the theoretical domains framework of behaviour change to investigate implementation problems. *Implementation Science, 12*. doi:10.1186/s13012-017-0605-9

Atlantis, E., Fahey, P., & Foster, J. (2014). Collaborative care for comorbid depression and diabetes: A systematic review and meta-analysis. *BMJ Open, 4*(4).

Atzmüller, C., & Steiner, P. (2010). Experimental vignette studies in survey research. *Methodology*.

Australian Bureau of Statistics. (2018). *Census of population and housing: Socio-economic indexes for areas (SEIFA) Australia 2016*. cat. no. 2033.0.55.001. Canberra, Australia: Australian Bureau of Statistics Retrieved from https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/2033.0.55.001~2016~Main%20Features~Data~2

Australian Government Department of Health. (2019). *Medicare benefits schedule book*. Canberra: Australian Government Department of Health Retrieved from http://www.mbsonline.gov.au/

Australian Government Department of Health. (2020). Australia's physical activity and sedentary behaviour guidelines for adults. Retrieved from

https://www1.health.gov.au/internet/main/publishing.nsf/Content/health-pubhlth-strateg-phys-act-guidelines#npa1864

Australian Health Ministers' Advisory Council. (2017). *National strategic framework for chronic conditions*. Canberra: Australian Government Department of Health Retrieved from https://www.health.gov.au/resources/publications/national-strategic-framework-for-chronic-conditions

Australian Industry and Skills Committee. (2020). National industry insights report: Sport, fitness and recreation. Retrieved from https://nationalindustryinsights.aisc.net.au/industries/sport-fitness-and-recreation

Australian Institute of Health and Welfare. (2017). *Impact of physical inactivity as a risk factor for chronic conditions*. Canberra: Autralian Institute of Health and Welfare Retrieved from https://www.aihw.gov.au/getmedia/df392a65-8cf3-4c09-a494-4498ede2c662/aihw-bod-16.pdf.aspx?inline=true

Australian Institute of Health and Welfare. (2018a). *Australia's health 2018*. cat. no. AUS 221. Canberra: Australian Institute of Health and Welfare Retrieved from https://www.aihw.gov.au/reports/australias-health/australias-health-2018/contents/table-of-contents

Australian Institute of Health and Welfare. (2018b). *Physical activity across the life stages*. cat. no. PHE 225. Canberra: Australian Institute of Health and Welfare Retrieved from https://www.aihw.gov.au/reports/physical-activity/physical-activity-across-the-life-stages/contents/table-of-contents

Australian Institute of Health and Welfare. (2019). *Australian burden of disease study: Impact and causes of illness and death in Australia 2015*. cat. no. BOD 22. Canberra Retrieved from https://www.aihw.gov.au/reports/burden-of-disease/burden-disease-study-illness-death-2015/contents/table-of-contents

Avery, L., Flynn, D., Dombrowski, S. U., van Wersch, A., Sniehotta, F. F., & Trenell, M. I. (2015). Successful behavioural strategies to increase physical activity and improve glucose control in adults with Type 2 diabetes. *Diabetic Medicine, 32*(8), 1058-1062. doi:10.1111/dme.12738

Avery, L., Flynn, D., van Wersch, A., Sniehotta, F. F., & Trenell, M. I. (2012). Changing physical activity behavior in type 2 diabetes: A systematic review and meta-analysis of behavioral interventions. *Diabetes Care, 35*(12), 2681-2689. doi:10.2337/dc11-2452

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215. doi:10.1037//0033-295x.84.2.191

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs: Prentice Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W H Freeman.

Baumhakel, M., Muller, U., & Bohm, M. (2009). Influence of gender of physicians and patients on guideline-recommended treatment of chronic heart failure in a cross-sectional study. *European Journal of Heart failure, 11*(3), 299-303. doi:10.1093/eurjhf/hfn041

Beedie, C., Mann, S., Jimenez, A., Kennedy, L., Lane, A., Domone, S., . . . Whyte, G. (2016). Death by effectiveness: Exercise as medicine caught in the efficacy trap! *British Journal of Sports Medicine, 50*, 323-324. doi:10.1136/bjsports-2014-094389

Bennie, J. A., Pedisic, Z., van Uffelen, J. G., Gale, J., Banting, L. K., Vergeer, I., . . . Biddle, S. J. (2015). The descriptive epidemiology of total physical activity, muscle-strengthening exercises and sedentary behaviour among Australian adults-results from the National Nutrition and Physical Activity Survey. *BMC Public Health, 16*. doi:10.1186/s12889-016-2736-3

Berger, B. G., Pargman, D., & Weinberg, R. S. (2006). Practice guidelines for optimal psychological benefits: Exercise frequency, intensity, and duration. In *Foundations of Exercise Psychology* (2 ed., pp. 389-413). Morgantown: Fitness Information Technology.

Berthold, H. K., Gouni-Berthold, I., Bestehorn, K. P., Böhm, M., & Krone, W. (2008). Physician gender is associated with the quality of type 2 diabetes care. *Journal of Internal Medicine, 264*(4), 340-350. doi:10.1111/j.1365-2796.2008.01967

Biddle, S. J., & Vergeer, I. (2019). Public health perspective on motivation and behaviour change in physical activity. In T. S. Horn & A. L. Smith (Eds.), *Advances in Sport and Exercise Psychology* (4 ed., pp. 333-349). Champaign, IL: Human Kinetics.

Blair, S. N., Kampert, J. B., Kohl, H. W., 3rd., Barlow, C. E., Macera, C. A., Paffenbarger, R. S., Jr., & Gibbons, L. W. (1996). Influences of cardiorespiratory fitness and other precursors on cardiovascular disease and all-cause mortality in men and women. *Journal of the Amercian Medical Association, 276*(3), 205-210. doi:10.1001/jama.1996.03540030039029

Blanchard, C. M., Fortier, M., Sweet, S., O'Sullivan, T., Hogg, W., Reid, R. D., & Sigal, R. J. (2007). Explaining physical activity levels from a self-efficacy perspective: The physical activity counseling trial. *Annals of Behavioral Medicine, 34*(3), 323-328. doi:10.1007/BF02874557

Bodenheimer, T., Lorig, K., Holman, H., & Grumbach, K. (2002). Patient self-management of chronic disease in primary care. *Journal of the Amercian Medical Association, 288*(19), 2469-2475. doi:10.1001/jama.288.19.2469

Boule, N. G., Haddad, E., Kenny, G. P., Wells, G. A., & Sigal, R. J. (2001). Effects of exercise on glycemic control and body mass in type 2 diabetes mellitus: A meta-

analysis of controlled clinical trials. *Journal of the Amercian Medical Association, 286*(10), 1218-1227. doi:10.1001/jama.286.10.1218

Boutcher, S., McAuley, E., & Courneya, K. S. (1997). Positive and negative affective response of trained and untrained subjects during and after aerobic exercise. *Australian Journal of Psychology, 49*, 28-32. doi:10.1080/00049539708259847

Bowling, A. (2014). *Research methods in health: Investigating health and health services*. United Kingdom: Open University Press.

Brand, R., & Ekkekakis, P. (2018). Affective-reflective theory of physical inactivity and exercise. *German Journal of Exercise and Sport Research, 48*(1), 48-58. doi:10.1007/s12662-017-0477-9

Burton, N. W., & Turrell, G. (2000). Occupation, hours worked, and leisure-time physical activity. *Preventive Medicine, 31*(6), 673-681. doi:10.1006/pmed.2000.0763

Cane, J., O'Connor, D., & Michie, S. (2012). Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implementation Science, 7*. doi:10.1186/1748-5908-7-37

Cane, J., Richardson, M., Johnston, M., Ladha, R., & Michie, S. (2015). From lists of behaviour change techniques to structured hierarchies: comparison of two methods of developing a hierarchy of BCTs. *British Journal of Health Psychology, 20*, 130-150. doi:10.1111/bjhp.12102

Carey, J. (1993). Linking qualitative and quantitative methods: Integrating cultural factors into public health. *Qualitative Health Research, 3*(3), 298-318. doi:10.1177/104973239300300303

Carver, C. S., & Scheier, M. F. (1982). Control theory: A useful conceptual framework for personality-social, clinical, and health psychology. *Psychological Bulletin, 92*(1), 111-135. doi:1982-26944-001

Casebeer, A. L., & Verhoef, M. J. (1997). Combining qualitative and quantitative research methods: Considering the possibilities for enhancing the study of chronic diseases. *Chronic Diseases in Canada, 18*(3), 130-135.

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports, 100*(2), 126-131.

Christ-Roberts, C. Y., Pratipanawatr, T., Pratipanawatr, W., Berria, R., Belfort, R., Kashyap, S., & Mandarino, L. J. (2004). Exercise training increases glycogen synthase activity and GLUT4 expression but not insulin signaling in overweight nondiabetic and type 2 diabetic subjects. *Metabolism, 53*(9), 1233-1242. doi:10.1016/j.metabol.2004.03.022

Churilla, J. R., Johnson, T. M., Magyari, P. M., & Crouter, S. E. (2012). Descriptive analysis of resistance exercise and metabolic syndrome. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy, 6*(1), 42-47. doi:10.1016/j.dsx.2012.05.004

Colberg, S. R., Sigal, R. J., Fernhall, B., Regensteiner, J. G., Blismer, B. J., Rubin, R. R., & Braun, B. (2012). Exercise and Type 2 diabetes the Amercian College of Sports Medicine and the American Diabetes Association joint position statement executive summary. *Diabetes Care, 33*(12), 2692-2696.

Courneya, K. S. (2010). Efficacy, effectiveness, and behavior change trials in exercise research. *International Journal of Behavioral Nutrition and Physical Activity, 7*(1). doi:10.1186/1479-5868-7-81

Cox, E. R., Keating, S. E., Coombes, J. S., & Burton, N. W. (2019). Potential utility of self-report measures of affect to optimise exercise adherence in people with type 2 diabetes. *Current Diabetes Reviews, 15*(4), 302-308. doi:10.2174/1573399814666180816165351

Cox, N. S., Oliveria, C., Lahham, A., & Holland, A. E. (2017). Understanding barriers and facilitators to pulmonary rehabilitation referral, uptake and participation using the theoretical domains framework: A systematic review. *American Journal of Respiratory and Critical Care Medicine*.

Cradock, K. A., ÓLaighin, G., Finucane, F. M., Gainforth, H. L., Quinlan, L. R., & Martin Ginis, K. A. (2017). Behaviour change techniques targeting both diet and physical activity in type 2 diabetes: A systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity, 14*(1). doi:10.1186/s12966-016-0436-0

Craike, M., Wiesner, G., Enticott, J., Bennie, J. A., & Biddle, S. J. (2018). Equity of a government subsidised exercise referral scheme: A population study. *Social Science and Medicine, 216,* 20-25. doi:10.1016/j.socscimed.2018.09.023

Craike, M. J., Gaskin, C. J., Mohebbi, M., Courneya, K. S., & Livingston, P. M. (2018). Mechanisms of physical activity behavior change for prostate cancer survivors: a cluster randomized controlled trial. *Annals of Behavioral Medicine, 52*(9), 798-808. doi:10.1093/abm/kax055

Creswell, J. W. (2011). Controversies in mixed methods research. In N. K. Denzin & Y. S. Lincoln (Eds.), *The SAGE Handbook of Qualitative Research* (Vol. 4, pp. 269-284). Thousand Oaks, CA: SAGE Publications.

Creswell, J. W. (2014). *A concise introduction to mixed methods research*. Thousand Oaks, CA: SAGE Publications.

Curran, G. M., Bauer, M., Mittman, B., Pyne, J. M., & Stetler, C. (2012). Effectiveness-implementation hybrid designs: combining elements of clinical effectiveness and implementation research to enhance public health impact. *Medical Care, 50*(3), 217.

Curtis, E., & Drennan, J. (2013). *Quantitative health research: Issues and methods*. United Kingdom: McGraw-Hill Education.

Daly, R. M., Dunstan, D. W., Owen, N., Jolley, D., Shaw, J. E., & Zimmet, P. Z. (2005). Does high-intensity resistance training maintain bone mass during moderate weight loss in older overweight adults with type 2 diabetes? *Osteoporosis International, 16*(12), 1703-1712. doi:10.1007/s00198-005-1906-4

Davis, R., Campbell, R., Hildon, Z., & Michie, S. (2014). Theories of behaviour and behaviour change across disciplines: a scoping review. *Health Psychology Review, 9*(3), 323-344.

de Souto Barreto, P., Ferrandez, A.-M., & Saliba-Serre, B. (2013). Are older adults who volunteer to participate in an exercise study fitter and healthier than nonvolunteers? The participation bias of the study population. *Journal of Physical Activity and Health, 10*(3), 359-367. doi:10.1123/jpah.10.3.359

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin, 125*(6), 627-668. doi:10.1037/0033-2909.125.6.627

Deloitte Access Economics. (2015). The value of accredited exercise physiologists to consumers in Australia Retrieved from https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-value-exercise-physiologists-Australia.pdf

Dennis, S. M., Zwar, N., Griffiths, R., Roland, M., Hasan, I., Powell Davies, G., & Harris, M. (2008). Chronic disease management in primary care: From evidence to policy. *Medical Journal of Australia, 188*(S8), 53-56. doi:10.5694/j.1326-5377.2008.tb01745.x

Denzin, N., & Lincoln, Y. (1995). Transforming qualitative research methods: Is it a revolution? *Journal of Contemporary Ethnography, 24*(3), 349-358. doi:10.1177/089124195024003006

DeVellis, R. F. (2016). Validity. In *Scale Development: Theory and Applications* (Vol. 4). Newbury Park, CA: SAGE Publications.

DiClemente, C. C., & Prochaska, J. O. (1998). Toward a comprehensive, transtheoretical model of change: Stages of change and addictive behaviors. In W. R. Miller & N. Heather (Eds.), *Applied clinical psychology: Treating addictive behaviors* (pp. 3-24). New York: Plenum Press.

Ding, D., Lawson, K. D., Kolbe-Alexander, T. L., Finkelstein, E. A., Katzmarzyk, P. T., van Mechelen, W., & Pratt, M. (2016). The economic burden of physical inactivity: A global analysis of major non-communicable diseases. *The Lancet, 388*(10051), 1311-1324. doi:10.1016/S0140-6736(16)30383-X

Dishman, R. K. (1988). *Exercise adherence: Its impact on public health*. Champaign, IL: Human Kinetics.

Dobson, F., Bennell, K., French, S., Nicolson, P., Klaasman, R., Holden, M., . . . Hinman, R. (2016). Barriers and facilitators to exercise participation in people with hip and/or knee osteoarthritis: Synthesis of the literature using behavior change theory. *American Journal of Physical Medicine Rehabilitation, 95*(5), 372-389. doi:10.1097/PHM.0000000000000448

Dombrowski, S. U., Sniehotta, F. F., Avenell, A., Johnston, M., MacLennan, G., & Araújo-Soares, V. (2012). Identifying active ingredients in complex behavioural interventions for obese adults with obesity-related co-morbidities or additional risk factors for co-morbidities: A systematic review. *Health Psychology Review, 6*(1), 7-32. doi:10.1080/17437199.2010.513298

Dorn, J., Naughton, J., Imamura, D., & Trevisan, M. (2001). Correlates of compliance in a randomized exercise trial in myocardial infarction patients. *Medicine & Science in Sports & Exercise, 33*(7), 1081-1089. doi:10.1097/00005768-200107000-00003

Dunn, A. L., Trivedi, M. H., & O'Neal, H. A. (2001). Physical activity dose-response effects on outcomes of depression and anxiety. *Medicine & Science in Sports & Exercise, 33*, S587-S597. doi:10.1097/00005768-200106001-00027

Dunstan, D. W., Daly, R. M., Owen, N., Jolley, D., De Courten, M., Shaw, J. E., & Zimmet, P. Z. (2002). High-intensity resistance training improves glycemic control in older patients with type 2 diabetes. *Diabetes Care, 25*(10), 1729-1736. doi:10.2337/diacare.25.10.1729

Dunstan, D. W., Daly, R. M., Owen, N., Jolley, D., Vulikh, E., Shaw, J. E., & Zimmet, P. Z. (2005). Home-based resistance training is not sufficient to maintain improved glycemic control following supervised training in older individuals with type 2 diabetes. *Diabetes Care, 28*(1), 3-9. doi:10.2337/diacare.28.1.3

Durstine, L., Gordon, B., Wang, Z., & Luo, X. (2013). Chronic disease and the link to physical activity. *Journal of Sport and Health Science, 2*(1), 3-11. doi:10.1016/j.jshs.2012.07.009

Ekkekakis, P. (2013). *The measurement of affect, mood, and emotion: A guide for health-behavioral research*: Cambridge University Press.

Ekkekakis, P. (2017). People have feelings! Exercise psychology in paradigmatic transition. *Current Opinion in Psychology, 16*, 84-88. doi:10.1016/j.copsyc.2017.03.018

Ekkekakis, P., & Dafermos, M. (2012). Exercise is a many-splendored thing, but for some it does not feel so splendid: Staging a resurgence of hedonistic ideas in the quest to understand exercise behavior. In E. O. Acevedo (Ed.), *The Oxford Handbook of Exercise Psychology*. New York, NY: Oxford University Press.

Ekkekakis, P., & Lind, E. (2006). Exercise does not feel the same when you are overweight: The impact of self-selected and imposed intensity on affect and exertion. *International Journal of Obesity, 30*(4), 652-660. doi:10.1038/sj.ijo.0803052

Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The pleasure and displeasure people feel when they exercise at different intensities. *Journal of Sports Medicine, 41*(8), 641-671. doi:10.2165/11590680

Ekkekakis, P., Vazou, S., Bixby, W. R., & Georgiadis, E. (2016). The mysterious case of the public health guideline that is (almost) entirely ignored: Call for a research agenda on the causes of the extreme avoidance of physical activity in obesity. *Obesity Reviews, 17*(4), 313-329. doi:10.1111/obr.12369

Elvins, R., & Green, J. (2008). The conceptualization and measurement of therapeutic alliance: An empirical review. *Clinical Psychology Review, 28*(7), 1167-1187. doi:10.1016/j.cpr.2008.04.002

Esain, I., Gil, S. M., Bidaurrazaga-Letona, I., & Rodriguez-Larrad, A. (2019). Effects of 3 months of detraining on functional fitness and quality of life in older adults who regularly exercise. *Aging clinical and experimental research, 31*(4), 503-510.

Evans, S. C., Roberts, M. C., Keeley, J. W., Blossom, J. B., Amaro, C. M., Garcia, A. M., . . . Reed, G. M. (2015). Vignette methodologies for studying clinicians' decision-making: Validity, utility, and application in ICD-11 field studies. *Int J Clin Health Psychol, 15*(2), 160-170. doi:10.1016/j.ijchp.2014.12.001

Exercise and Sports Science Australia. (2015a). Accredited Exercise Physiologist professional standards. Retrieved from https://www.essa.org.au/Public/Professional_Standards/The_professional_standards.aspx

Exercise and Sports Science Australia. (2015b). Accredited Exercise Physiologist scope of practice. Retrieved from https://www.essa.org.au/wp-content/uploads/2015/09/Scope-of-Practice-for-AEP.pdf

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behaviour: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Fishbein, M., Triandis, H. C., Kanfer, F. H., Becker, M., Middlestadt, S. E., & Eichler, A. (2001). Factors influencing behavior and behavior change. In A. Baum, T. Revenson, & J. Singer (Eds.), *Handbook of Health Psychology* (Vol. 3). Imahwah, NJ: Lawrence Erlbaum Associates.

Fisher, L., Skaff, M. M., Mullan, J. T., Arean, P., Mohr, D., Masharani, U., . . . Laurencin, G. (2007). Clinical depression versus distress among patients with type 2 diabetes: Not just a question of semantics. *Diabetes Care, 30*(3), 542-548.

Fitness Australia. (2016). Profile of the Australian Fitness Industry 2016. Retrieved from https://fitness.org.au/articles/category/profile-of-the-australian-fitness-industry-2016/108/19

Fitness Australia. (2019). Scope of practice for registered exercise professionals. Retrieved from https://fitness.org.au/articles/policies-guidelines/scope-of-practice-for-ausreps/4/38/20

Fortier, M., Sweet, S., O'Sullivan, T., & Williams, G. (2007). A self-determination process model of physical activity adoption in the context of a randomized controlled trial. *Psychology of Sport and Exercise, 8*(5), 741-757. doi:10.1016/j.psychsport.2006.10.006

Franklin, B. A., Swain, D. P., & Shephard, R. J. (2003). New insights in the prescription of exercise for coronary patients. *Journal of Cardiovascular Nursing, 18*(2), 116-123. doi:10.1097/00005082-200304000-00007

Galderisi, M. (2006). Diastolic dysfunction and diabetic cardiomyopathy: Evaluation by Doppler echocardiography. *Journal of the American College of Cardiology, 48*(8), 1548-1551. doi:10.1016/j.jacc.2006.07.033

Glasgow, R., Lichtenstein, E., & Marcus, A. (2003). Why don't we see more translation of health promotion research to practice? Rethinking the efficacy-to-effectiveness transition. *American Journal of Public Health, 93*(8), 1261-1267. doi:10.2105/AJPH.93.8.1261

Glowacki, K., Duncan, M. J., Gainforth, H., & Faulkner, G. (2017). Barriers and facilitators to physical activity and exercise among adults with depression: A scoping review. *Mental Health and Physical Activity, 13,* 108-119. doi:10.1016/j.mhpa.2017.10.001

Gonzalez, J. S., Peyrot, M., McCarl, L. A., Collins, E. M., Serpa, L., Mimiaga, M. J., & Safren, S. A. (2008). Depression and diabetes treatment nonadherence: A meta-analysis. *Diabetes Care, 31*(12), 2398-2403. doi:10.2337/dc08-1341

Gourlan, M., Bernard, P., Bortolon, C., Romain, A. J., Lareyre, O., Carayol, M., . . . Boiche, J. (2016). Efficacy of theory-based interventions to promote physical activity. A meta-analysis of randomised controlled trials. *Health Psychology Review, 10*(1), 50-66. doi:10.1080/17437199.2014.981777

Greenbank, P. (2003). The role of values in educational research: The case for reflexivity. *British Educational Research Journal, 29*(6), 791-801. doi:10.1080/0141192032000137303

Gregg, E. W., Gerzoff, R. B., Caspersen, C. J., Williamson, D. F., & Narayan, K. M. (2003). Relationship of walking to mortality among US adults with diabetes. *Archives of Internal Medicine, 163*(12), 1440-1447. doi:10.1001/archinte.163.12.1440

Grigsby, A. B., Anderson, R. J., Freedland, K. E., Clouse, R. E., & Lustman, P. J. (2002). Prevalence of anxiety in adults with diabetes: A systematic review. *Journal of Psychosomatic Research, 53*(6), 1053-1060. doi:10.1016/s0022-3999(02)00417-8

Grimshaw, J. M., Eccles, M. P., Lavis, J. N., Hill, S. J., & Squires, J. E. (2012). Knowledge translation of research findings. *Implementation Science, 7*(1). doi:10.1186/1748-5908-7-50

Grimshaw, J. M., Thomas, R. E., MacLennan, G., Fraser, C., Ramsay, C. R., Vale, L., . . . Donaldson, C. (2004). Effectiveness and efficiency of guideline dissemination and implementation strategies. *Health Technology Assessment, 8*(6), 1-72. doi:10.3310/hta8060

Grol, R. (2001). Successes and failures in the implementation of evidence-based guidelines for clinical practice. *Medical Care, 39*(8 Suppl 2), 1146-1154. doi:10.1097/00005650-200108002-00003

Hagger, M. S. (2009). Theoretical integration in health psychology: Unifying ideas and complementary explanations. *British Journal of Health Psychology, 14*(Pt 2), 189-194. doi:10.1348/135910708X397034

Hagger, M. S., & Chatzisarantis, N. L. (2014). An integrated behavior change model for physical activity. *Exercise and Sports Sciences Reviews, 42*(2), 62-69. doi:10.1249/JES.0000000000000008

Hagger, M. S., & Weed, M. (2019). Debate: Do interventions based on behavioral theory work in the real world? *International Journal of Behavioral Nutrition and Physical Activity, 16*(1), 36.

Hall, A. M., Ferreira, P. H., Maher, C. G., Latimer, J., & Ferreira, M. L. (2010). The influence of the therapist-patient relationship on treatment outcome in physical

rehabilitation: A systematic review. *Physical Therapy, 90*(8), 1099-1110. doi:10.2522/ptj.20090245

Hallal, P. C., Andersen, L. B., Bull, F. C., Guthold, R., Haskell, W., & Ekelund, U. (2012). Global physical activity levels: surveillance progress, pitfalls, and prospects. *The Lancet, 380*(9838), 247-257. doi:10.1016/S0140-6736(12)60646-1

Hambrecht, R., Niebauer, J., Marburger, C., Grunze, M., Kälberer, B., Hauer, K., . . . Schuler, G. (1993). Various intensities of leisure time physical activity in patients with coronary artery disease: Effects on cardiorespiratory fitness and progression of coronary atherosclerotic lesions. *Journal of the American College of Cardiology, 22*(2), 468-477. doi:10.1016/0735-1097(93)90051-2

Hankonen, N., Sutton, S., Prevost, A. T., Simmons, R. K., Griffin, S. J., Kinmonth, A. L., & Hardeman, W. (2014). Which behavior change techniques are associated with changes in physical activity, diet and body mass index in people with recently diagnosed diabetes? *Annals of Behavioral Medicine, 49*(1), 7-17. doi:10.1007/s12160-014-9624-9

Harriss, D. J., MacSween, A., & Atkinson, G. (2019). Ethical standards in sport and exercise science research: 2020 update. *International Journal of Sports Medicine, 40*(13), 813-817. doi:10.1055/a-1015-3123

Haynes, S., Richard, D., & Kubany, E. (1995). Content validity in psychological assessment: A functional approach to concepts and methods. *Psychological Assessment, 7*(3), 238. doi:10.1037/1040-3590.7.3.238

Helmrich, S. P., Ragland, D. R., Leung, R. W., & Paffenbarger, R. S., Jr. (1991). Physical activity and reduced occurrence of non-insulin-dependent diabetes mellitus. *New England Journal of Medicine, 325*(3), 147-152. doi:10.1056/NEJM199107183250302

Helmrich, S. P., Ragland, D. R., & Paffenbarger, R. S., Jr. (1994). Prevention of non-insulin-dependent diabetes mellitus with physical activity. *Medicine & Science in Sports & Exercise, 26*(7), 824-830.

Hickey, G., & Kipping, C. (1996). A multi-stage approach to the coding of data from open-ended questions. *Nurse Reserach, 4*(1), 81-91. doi:10.7748/nr.4.1.81.s9

Hill, C. E., Thompson, B. J., & Nutt Williams, E. (1997). A guide to conducting consensual qualitative research. *The Counseling Psychologist, 25*(4), 517-572. doi:10.1177/0011000097254001

Hinds, P. S., Vogel, R. J., & Clarke-Steffen, L. (1997). The possibilities and pitfalls of doing a secondary analysis of a qualitative data set. *Qualitative Health Research, 7*(3), 408-424.

Hobbs, L., Campbell, R., Hildon, Z., & Michie, S. (2011). Behaviour change theories across psychology, sociology, anthropology and economics: A systematic review. *Psychology and Health, 26*.

Holman, H. R. (1993). Qualitative inquiry in medical research. *Journal of Clinical Epidemiology, 46*(1), 29-36.

Holten, M. K., Zacho, M., Gaster, M., Juel, C., Wojtaszewski, J. F., & Dela, F. (2004). Strength training increases insulin-mediated glucose uptake, GLUT4 content, and insulin signaling in skeletal muscle in patients with type 2 diabetes. *Diabetes, 53*(2), 294-305. doi:10.2337/diabetes.53.2.294

Howitt, D., & Cramer, D. (2005). *Introduction to SPSS in Psychology: with supplements for releases 10, 11, 12 and 13*: Pearson education.

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qual Health Res, 15*(9), 1277-1288. doi:10.1177/1049732305276687

Jensen, G. M., Gwyer, J., & Shepard, K. F. (2000). Expert practice in physical therapy. *Physical Therapy, 80*(1), 28-52. doi:10.1093/ptj/80.1.28

Jordan, J. E., & Osborne, R. H. (2007). Chronic disease self-management education programs: Challenges ahead. *Medical Journal of Australia, 186*(2), 84-87. doi:10.5694/j.1326-5377.2007.tb00807.x

Katzmarzyk, P. T., Church, T. S., & Blair, S. N. (2004). Cardiorespiratory fitness attenuates the effects of the metabolic syndrome on all-cause and cardiovascular disease mortality in men. *Archives of Internal Medicine, 164*(10), 1092-1097. doi:10.1001/archinte.164.10.1092

Kelly, M. P., & Barker, M. (2016). Why is changing health-related behaviour so difficult? *Public Health, 136*, 109-116. doi:10.1016/j.puhe.2016.03.030

Kendzierski, D., & DeCarlo, K. J. (1991). Physical activity enjoyment scale: Two validation studies. *Journal of Sport & Exercise Psychology, 13*(1), 50-64.

Kennerly, A. M., & Kirk, A. (2018). Physical activity and sedentary behaviour of adults with type 2 diabetes: A systematic review. *Practical Diabetes, 35*(3), 86-89. doi:10.1002/pdi.2169

Kim, C., McEwen, L. N., Gerzoff, R. B., Marrero, D. G., Mangione, C. M., Selby, J. V., & Herman, W. H. (2005). Is physician gender associated with the quality of diabetes care? *Diabetes Care, 28*(7), 1594-1598. doi:10.2337/diacare.28.7.1594

Knowler, W. C., Barrett-Connor, E., Fowler, S. E., Hamman, R. F., Lachin, J. M., Walker, E. A., & Nathan, D. M. (2002). Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *New England Journal of Medicine, 346*(6), 393-403. doi:10.1056/NEJMoa012512

Kohl, H. W., 3rd, Craig, C. L., Lambert, E. V., Inoue, S., Alkandari, J. R., Leetongin, G., & Kahlmeier, S. (2012). The pandemic of physical inactivity: Global action for public health. *The Lancet, 380*, 294-305. doi:10.1016/S0140-6736(12)60898-8

Krosnick, J. A. (1999). Survey research. *Annu Rev Psychol, 50*(1), 537-567. doi:10.1146/annurev.psych.50.1.537

Kwasnicka, D., Dombrowski, S. U., White, M., & Sniehotta, F. (2016). Theoretical explanations for maintenance of behaviour change: A systematic review of behaviour theories. *Health Psychology Review, 10*(3), 277-296. doi:10.1080/17437199.2016.1151372

Laaksonen, D. E., Lindstrom, J., Lakka, T. A., Eriksson, J. G., Niskanen, L., Wikstrom, K., . . . Uusitupa, M. (2005). Physical activity in the prevention of type 2 diabetes: The Finnish diabetes prevention study. *Diabetes, 54*(1), 158-165. doi:10.2337/diabetes.54.1.158

Lederman, O., Grainger, K., Stanton, R., Douglas, A., Gould, K., Perram, A., . . . Semaan, A. (2016). Consensus statement on the role of Accredited Exercise Physiologists within the treatment of mental disorders: A guide for mental health professionals. *Australasian Psychiatry, 24*(4), 347-351. doi:10.1177/1039856216632400

Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., & Katzmarzyk, P. T. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. *The Lancet, 380*(9838), 219-229. doi:10.1016/S0140-6736(12)61031-9

Leung, F. H., & Savithiri, R. (2009). Spotlight on focus groups. *Can Fam Physician, 55*(2), 218-219.

Liamputtong, P., & Ezzy, D. (2005). *Qualitative research methods. Second*: New York: Oxford University Press.

Lincoln, Y. S., & Denzin, N. K. (2003). *Turning points in qualitative research: Tying knots in a handkerchief* (Vol. 2). Lanham, MD: Rowman Altamira.

Lönnqvist, J. E., Verkasalo, M., & Bezmenova, I. (2007). Agentic and communal bias in socially desirable responding. *European Journal of Personality, 21*(6), 853-868. doi:10.1002/per.639

Lunt, H., Draper, N., Marshall, H. C., Logan, F. J., Hamlin, M. J., Shearman, J. P., . . . Frampton, C. M. (2014). High intensity interval training in a real world setting: A randomized controlled feasibility study in overweight inactive adults, measuring change in maximal oxygen uptake. *PLoS One, 9*(3). doi:10.1371/journal.pone.0083256

Lynch, J., Helmrich, S. P., Lakka, T. A., Kaplan, G. A., Cohen, R. D., Salonen, R., & Salonen, J. T. (1996). Moderately intense physical activities and high levels of cardiorespiratory fitness reduce the risk of non-insulin-dependent diabetes mellitus in middle-aged men. *Archives of Internal Medicine, 156*(12), 1307-1314. doi:10.1001/archinte.1996.00440110073010

Macera, C. A., Hootman, J. M., & Sniezek, J. E. (2003). Major public health benefits of physical activity. *Arthritis & Rheumatology, 49*(1), 122-128. doi:10.1002/art.10907

Macera, C. A., & Powell, K. E. (2001). Population attributable risk: Implications of physical activity dose. *Medicine & Science in Sports & Exercise, 33*, S635-641. doi:10.1097/00005768-200106001-00032

Mann, S., Beedie, C., & Jimenez, A. (2014). Differential effects of aerobic exercise, resistance training and combined exercise modalities on cholesterol and the lipid profile: Review, synthesis and recommendations. *Sports Medicine, 44*(2), 211-221. doi:10.1007/s40279-013-0110-5

Manson, J. E., Nathan, D. M., Krolewski, A. S., Stampfer, M. J., Willett, W. C., & Hennekens, C. H. (1992). A prospective study of exercise and incidence of diabetes among US male physicians. *Journal of the Amercian Medical Association, 268*(1), 63-67. doi:10.1001/jama.1992.03490010065031

Marshall, S. J., & Biddle, S. J. (2001). The transtheoretical model of behavior change: A meta-analysis of applications to physical activity and exercise. *Annals of Behavioral Medicine, 23*(4), 229-246. doi:10.1207/S15324796ABM2304_2

Mast, M. S., & Kadji, K. K. (2018). How female and male physicians' communication is perceived differently. Patient Education and Counseling, *101*(9), 1697-1701.

McAuley, E., & Blissmer, B. (2000). Self-efficacy determinants and consequences of physical activity. *Exercise & Sport Sciences Reviews, 28*(2), 85-88.

McAuley, E., Morris, K. S., Motl, R. W., Hu, L., Konopack, J. F., & Elavsky, S. (2007). Long-term follow-up of physical activity behavior in older adults. *Health Psychology, 26*(3), 375-380.

McCrae, R. R., & Costa, P. T. J. (1992). Discriminant validity of NEO personality inventory facet scales. *Educational and Psychological Measurement, 52*(1), 229-237. doi:10.1177/001316449205200128

McEachan, R. R. C., Conner, M., Taylor, N. J., & Lawton, R. J. (2011). Prospective prediction of health-related behaviours with the theory of planned behaviour: A meta-analysis. *Health Psychology Review, 5*(2), 97-144. doi:10.1080/17437199.2010.521684

Mezuk, B., Eaton, W. W., Albrecht, S., & Golden, S. H. (2008). Depression and type 2 diabetes over the lifespan: A meta-analysis. *Diabetes Care, 31*(12), 2383-2390. doi:10.2337/dc08-0985

Michie, S. (2008). Designing and implementing behaviour change interventions to improve population health. *The Journal of Health Services and Research Policy, 13*, 64-69. doi:10.1258/jhsrp.2008.008014

Michie, S., Abraham, C., Whittington, C., McAteer, J., & Gupta, S. (2009). Effective techniques in healthy eating and physical activity interventions: A meta-regression. *Journal of Health Psychology, 28*(6), 690-701. doi:10.1037/a0016136

Michie, S., Ashford, S., Sniehotta, F. F., Dombrowski, S. U., Bishop, A., & French, D. P. (2011). A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: The CALO-RE taxonomy. *Psychology & Health, 26*(11), 1479-1498. doi:10.1080/08870446.2010.540664

Michie, S., Atkins, L., & West, R. (2014). *The behaviour change wheel: A guide to designing interventions*. London: Silverback Publishing.

Michie, S., Carey, R. N., Johnston, M., Rothman, A., de Bruin, M., Kelly, M. P., & Connell, L. E. (2018). From theory-inspired to theory-based interventions: A protocol for developing and testing a methodology for linking behaviour change techniques to theoretical mechanisms of action. *Annals of Behavioral Medicine, 52*(6), 501-512. doi:10.1007/s12160-016-9816-6

Michie, S., Jochelson, K., Markham, W. A., & Bridle, C. (2009). Low-income groups and behaviour change interventions: A review of intervention content, effectiveness and theoretical frameworks. *Journal of Epidemiology and Community Health, 63*(8), 610-622. doi:10.1136/jech.2008.078725

Michie, S., Johnston, M., Abraham, C., Lawton, R., Parker, D., & Walker, A. (2005). Making psychological theory useful for implementing evidence based practice: A consensus approach. *Quality & Safety in Health Care, 14*(1), 26-33. doi:10.1136/qshc.2004.011155

Michie, S., Johnston, M., Francis, J., & Hardeman, W. (2005). *Behaviour change interventions: Developing a classification system.* Paper presented at the 1st annual conference of the UK Society for Behavioural Medicine, London.

Michie, S., Johnston, M., Francis, J., Hardeman, W., & Eccles, M. (2008). From theory to intervention: mapping theoretically derived behavioural determinants to behaviour change techniques. *Applied Psychology, 57*(4), 660-680. doi:10.1111/j.1464-0597.2008.00341.x

Michie, S., Miles, J., & Weinman, J. (2003). Patient-centredness in chronic illness: What is it and does it matter? *Patient Education and Counselling, 51*(3), 197-206. doi:0.1016/S0738-3991(02)00194-5

Michie, S., & Prestwich, A. (2010). Are interventions theory-based? Development of a theory coding scheme. *Health Psychology, 29*(1), 1-8. doi:10.1037/a0016939

Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., . . . Wood, C. E. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: Building an international consensus for the reporting of behavior change interventions. *Annals of Behavioural Medicine, 46*(1), 81-95. doi:10.1007/s12160-013-9486-6

Michie, S., West, R., Campbell, R., Brown, J., & Gainforth, H. (2014). *ABC of behaviour change theories: An essential resource for researchers, policy makers and practitioners*. London: Silverback Publishing.

Michie, S., Wood, C. E., Johnston, M., Abraham, C., Francis, J. J., & Hardeman, W. (2015). Behaviour change techniques: The development and evaluation of a taxonomic method for reporting and describing behaviour change interventions (a suite of five studies involving consensus methods, randomised controlled trials and analysis of

qualitative data). *Health Technology Assessment, 19*(99), 1-188. doi:10.3310/hta19990

Moher, D., Hopewell, S., Schulz, K. F., Montori, V., Gotzche, P. C., Devereaux, P. J., . . . Altmam, D. G. (2012). CONSORT 2010 explanation and elaboration: Updated guidelines for reporting parallel group randomized trials. *International Journal of Surgery, 10*(1), 28-55. doi:10.1016/j.ijsu.2011.10.001

Moore, A. J., Holden, M. A., Foster, N. E., & Jinks, C. (2020). Therapeutic alliance appears to facilitate adherence to physiotherapy-led exercise and physical activity for older adults with knee pain: A longitudinal qualitative study. *Journal of Physiotherapy, 66*(1), 45-53. doi:10.1016/j.jphys.2019.11.004

Moore, G. E. (2004). The role of exercise prescription in chronic disease. *British Journal of Sports Medicine, 38*(1), 6-7. doi:10.1136/bjsm.2003.010314

Morrato, E., Hill, J., Wyatt, H., Ghushchyan, V., & Sullivan, P. (2007). Physical activity in US adults with diabetes and at risk for developing diabetes 2003. *Diabetes Care, 30*(2), 203-209. doi:10.2337/dc06-1128

Morrow, V., Boddy, J., & Lamb, R. (2014). The ethics of secondary data analysis: Learning from the experience of sharing qualitative data from young people and their families in an international study of childhood poverty. London: Thomas Coram Research Unit and the Institute of Education University of London Available at: http://sro. sussex. ac. uk/49123/1/NOVELLA_NCRM_ethics_of_secondary_analysis. pdf.

Myers, J., Kaykha, A., George, S., Abella, J., Zaheer, N., Lear, S., . . . Froelicher, V. (2004). Fitness versus physical activity patterns in predicting mortality in men. *The American Journal of Medicine, 117*(12), 912-918. doi:10.1016/j.amjmed.2004.06.047

National Heart Lung and Blood Institute. (1998). *Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: The evidence report*. Retrieved from Bethesda, MA:

Nicholson, S. L., Donaghy, M., Johnston, M., Sniehotta, F. F., van Wijck, F., Johnston, D., . . . Mead, G. (2014). A qualitative theory guided analysis of stroke survivors' perceived barriers and facilitators to physical activity. *Disability and Rehabilitation, 36*(22), 1857-1868. doi:10.3109/09638288.2013.874506

Nocon, M., Hiemann, T., Muller-Riemenschneider, F., Thalau, F., Roll, S., & Willich, S. N. (2008). Association of physical activity with all-cause and cardiovascular mortality: A systematic review and meta-analysis. *European Journal of Cardiovascular Prevention and Rehabilitation, 15*(3), 239-246. doi:10.1097/HJR.0b013e3282f55e09

Nolan, R. C., Raynor, A. J., Berry, N. M., & May, E. J. (2016). Self-reported physical activity using the International Physical Activity Questionnaire (IPAQ) in Australian adults with type 2 diabetes, with and without peripheral neuropathy. *Canadian Journal of Diabetes, 40*(6), 576-579. doi:10.1016/j.jcjd.2016.05.013

Norton, K., Norton, L., & Sadgrove, D. (2010). Position statement on physical activity and exercise intensity terminology. *Journal of Science and Medicine in Sport, 13*(5), 496-502. doi:10.1016/j.jsams.2009.09.008

O'Gorman, D. J., Karlsson, H. K., McQuaid, S., Yousif, O., Rahman, Y., Gasparro, D., . . . Nolan, J. J. (2006). Exercise training increases insulin-stimulated glucose disposal and GLUT4 (SLC2A4) protein content in patients with type 2 diabetes. *Diabetologia, 49*(12), 2983-2992. doi:10.1007/s00125-006-0457-3

Olander, E., Fletcher, H., Williams, S., Atkinson, L., Turner, A., & French, D. (2013). What are the most effective techniques in changing obese individuals' physical activity self-

efficacy and behaviour: A systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity, 10*(1). doi:10.1186/1479-5868-10-29

Paffenbarger, R., Hyde, R., Wing, A., Lee, I.-M., Jung, D., & Kampert, J. (1993). The association of changes in physical-activity level and other lifestyle characteristics with mortality among men. *New England Journal of Medicine, 328*(8), 538-545. doi:10.1056/NEJM199302253280804

Pallant, J. (2016). *SPSS survival manual: A step-by-step guide to data analysis using IBM SPSS* (6 ed.). Australia: Allen & Unwin.

Patton, M. Q. (2002). *Qualitative research & evaluation methods* (4 ed.). Saint Paul, MN: SAGE Publications.

Penn, L., Dombrowski, S. U., Sniehotta, F. F., & White, M. (2013). Participants' perspectives on making and maintaining behavioural changes in a lifestyle intervention for type 2 diabetes prevention: A qualitative study using the theory domain framework. *BMJ Open, 3*(6). doi:10.1136/bmjopen-2013-002949

Perry, B. D., Caldow, M. K., Brennan-Speranza, T. C., Sbaraglia, M., Jerums, G., Garnham, A., . . . Levinger, I. (2016). Muscle atrophy in patients with Type 2 diabetes mellitus: Roles of inflammatory pathways, physical activity and exercise. *Exercise Immunology Review, 22*, 94-109.

Potter, W. J., & Levine-Donnerstein, D. (1999). Rethinking validity and reliability in content analysis. *Journal of Applied Communication Research, 27*(3), 258-284. doi:10.1080/00909889909365539

Prestwich, A., Sniehotta, F. F., Whittington, C., Dombrowski, S. U., Rogers, L., & Michie, S. (2014). Does theory influence the effectiveness of health behavior interventions? Meta-analysis. *Health Psychology, 33*(5), 465-474. doi:10.1037/a0032853

Prochaska, J. O., & DiClemente, C. C. (1982). Transtheoretical therapy: Toward a more integrative model of change. *Psychotherapy: Theory, Research & Practice, 19*(3), 276-288. doi:10.1037/h0088437

Prochaska, J. O., Wright, J. A., & Velicer, W. F. (2008). Evaluating theories of health behavior change: A hierarchy of criteria applied to the transtheoretical model. *Applied Psychology, 57*(4), 561-588. doi:10.1111/j.1464-0597.2008.00345.x

Resnick, H., Foster, G., Bardsley, J., & Ratner, R. (2006). Achievement of American Diabetes Association clinical practice recommendations among US adults with diabetes 1999-2002. *Diabetes Care, 29*(3), 531-537. doi:10.2337/diacare.29.03.06.dc05-1254

Resnik, L., & Hart, D. L. (2003). Using clinical outcomes to identify expert physical therapists. Physical Therapy, *83*(11), 990-1002.

Rhodes, R. E., McEwan, D., & Rebar, A. L. (2018). Theories of physical activity behaviour change: A history and synthesis of approaches. *Psychology of Sport and Exercise, 42*, 100-109. doi:10.1016/j.psychsport.2018.11.010

Rhodes, R. E., & Nigg, C. R. (2011). Advancing physical activity theory: A review and future directions. *Exercise and Sport Sciences Reviews, 39*(3), 113-119. doi:10.1097/JES.0b013e31821b94c8

Ritchie, J., Lewis, J., McNaughton Nicholls, C., & Ormston, R. (2013). *Qualitative research practice: A guide for social science students and researchers* (2 ed.). Thousand Oaks, CA: Sage Publications.

Rosenthal, R., & Rosnow, R. L. (1975). *Primer of methods for the behavioral sciences*. New York: John Wiley & Sons.

Ross, R., & McGuire, A. (2011). Incidental physical activity is positively associated with cardiorespiratory fitness. *Journal Medicine Science in Sports Exercise, 43*(11), 2189-2194.

Roter, D. L., Hall, J. A., & Aoki, Y. (2002). Physician gender effects in medical communication: A meta-analytic review. *Journal of the Amercian Medical Association, 288*(6), 756-764. doi:10.1001/jama.288.6.756

Roy, T., & Lloyd, C. E. (2012). Epidemiology of depression and diabetes: A systematic review. *Journal of Affective Disorders, 142* S8-S21. doi:10.1016/S0165-0327(12)70004-6

Rubin, R., Ma, Y., Marrero, D. G., Peyrot, M., Barrett-Connor, E., Kahn, S., . . . Knowler, W. (2008). Elevated depression symptoms, antidepressant medicine use, and risk of developing diabetes during the diabetes prevention program. *Diabetes Care, 31*(3), 420-426. doi:10.2337/dc07-1827

Russell, J. A. (2003). Core affect and the psychological construction of emotion. *Psychological Review, 110*(1), 145-172. doi:10.1037/0033-295X.110.1.145

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68-78. doi:10.1037//0003-066x.55.1.68

Sallis, J. F., Hovell, M. F., Hofstetter, C. R., & Barrington, E. (1992). Explanation of vigorous physical activity during two years using social learning variables. *Social Science & Medicine, 34*(1), 25-32.

Samitz, G., Egger, M., & Zwahlen, M. (2011). Domains of physical activity and all-cause mortality: Systematic review and dose-response meta-analysis of cohort studies. *International Journal of Epidemiology, 40*(5), 1382-1400. doi:10.1093/ije/dyr112

Sandelowski, M. (1997). “To be of use”: Enhancing the utility of qualitative research. *Nursing Outlook, 45*(3), 125-132.

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., . . . Jinks, C. (2018). Saturation in qualitative research: exploring its conceptualization and operationalization. *Quality & Quantity, 52*(4), 1893-1907.

Schuster, M. A., McGlynn, E. A., & Brook, R. H. (2005). How good is the quality of health care in the United States? *The Milbank Quarterly, 83*(4), 843-895. doi:10.1111/1468-0009.00105

Schwarzer, R. (2016). Health action process approach (HAPA) as a theoretical framework to understand behavior change. *Actualidades en Psicología, 30*(121), 119-130. doi:10.15517/ap.v30i121.23458

Sigal, R., Kenny, G., Boulé, N., Wells, G., Prud'homme, D., Fortier, M., . . . Phillips, P. (2007). Effects of aerobic training, resistance training, or both on glycemic control in type 2 diabetes: A randomized trial. *Annals of Internal Medicine, 147*(6), 357-369. doi:10.7326/0003-4819-147-6-200709180-00005

Simpson, K. A., Mavros, Y., Kay, S., Meiklejohn, J., de Vos, N., Wang, Y., . . . Singh, M. A. (2015). Graded resistance exercise and type 2 diabetes in older adults (the GREAT2DO study): Methods and baseline cohort characteristics of a randomized controlled trial. *Trials, 16*(1). doi:10.1186/s13063-015-1037-y

Sofi, F., Capalbo, A., Cesari, F., Abbate, R., & Gensini, G. F. (2008). Physical activity during leisure time and primary prevention of coronary heart disease: An updated meta-analysis of cohort studies. *European Journal of Cardiovascular Prevention and Rehabilitation, 15*(3), 247-257. doi:10.1097/HJR.0b013e3282f232ac

Spence, J. C., Burgess, J. A., Cutumisu, N., Lee, J. G., Moylan, B., Taylor, L., & Witcher, C. S. (2006). Self-efficacy and physical activity: A quantitative review. *Journal of Sport & Exercise Psychology, 28*, S172-S173.

Stanton, R. (2013). Accredited exercise physiologists and the treatment of people with mental illnesses. *Community Health, 4*. doi:10.5923/j.cp.20130202.01

Sternfeld, B., Ainsworth, B. E., & Quesenberry, C. P. (1999). Physical activity patterns in a diverse population of women. *Preventive Medicine, 28*(3), 313-323.

Stickler, K., Sabus, C., Gustafson, H., Kueser, M., Lavaveshkul, B., & Denney, L. (2016). Pro-bono service through student-run clinics: How does physical therapy measure up? *Journal of Allied Health, 45*(3), 207-211.

Stødle Vestøl, I., Debesay, J., Pajalic, Z., & Bergland, A. (2020). The importance of a good therapeutic alliance in promoting exercise motivation in a group of older Norwegians in the subacute phase of hip fracture: A qualitative study. *BMC Geriatrics*. doi:10.1186/s12877-020-01518-7

Strohacker, K., Galarraga, O., & Williams, D. M. (2014). The impact of incentives on exercise behavior: A systematic review of randomized controlled trials. *Annals of Behavioral Medicine, 48*(1), 92-99. doi:10.1007/s12160-013-9577-4

Sweet, S. N., Fortier, M. S., Guerin, E., Tulloch, H., Sigal, R. J., Kenny, G. P., & Reid, R. D. (2009). Understanding physical activity in adults with type 2 diabetes after completing an exercise intervention trial: A mediation model of self-efficacy and autonomous motivation. *Psychology, Health & Medicine, 14*(4), 419-429. doi:10.1080/13548500903111806

Sweet, S. N., Perrier, M.-J., Saunders, C., Caron, J. G., & Dufour Neyron, H. (2019). What keeps them exercising? A qualitative exploration of exercise maintenance post-

cardiac rehabilitation. *International Journal of Sport and Exercise Psychology, 17*(4), 381-396. doi:10.1080/1612197X.2017.1362458

Szabo, V., & Strang, V. R. (1997). Secondary analysis of qualitative data. *Advances in Nursing Science, 20*(2), 66-74.

Tabachnick, B. G., & Fidell, L. S. (2019). *Using multivariate statistics* (Vol. 7). Boston, MA: Pearson

Tanamas, S. K., Magliano, D. J., Lynch, B., Sethi, P., Willenberg, L., Polkinghorne, K. R., . . . Shaw, J. E. (2013). *The Australian diabetes, obesity and lifestyle study*. Melbourne, Australia: Baker Heart and Diabetes Institute.

Taylor, R. S., Brown, A., Ebrahim, S., Jolliffe, J., Noorani, H., Rees, K., . . . Oldridge, N. (2004). Exercise-based rehabilitation for patients with coronary heart disease: Systematic review and meta-analysis of randomized controlled trials. *The American Journal of Medicine, 116*(10), 682-692. doi:10.1016/j.amjmed.2004.01.009

Teddlie, C., & Tashakkori, A. (2009). *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences*. Thousand Oaks, CA: SAGE Publications.

Teixeira, P. J., Carraca, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 9*(1). doi:10.1186/1479-5868-9-78

Thorne, S. (1994). Secondary analysis in qualitative research: Issues and implications. *Critical Issues in Qualitative Research Methods, 1*, 263-279.

Timmons, J. F., Griffin, C., Cogan, K. E., Matthews, J., & Egan, B. (2020). Exercise maintenance in older adults 1 year after completion of a supervised training

intervention. *Journal of the American Geriatrics Society, 68*(1), 163-169. doi:10.1111/jgs.16209

Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. International Journal for Quality in Health Care, *19*(6), 349-357.

Tripathy, J. P. (2013). Secondary data analysis: Ethical issues and challenges. Iranian Journal of Public Health, *42*(12), 1478.

Tuomilehto, J., Lindström, J., Eriksson, J. G., Valle, T. T., Hämäläinen, H., Ilanne-Parikka, P., . . . Rastas, M. (2001). Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *New England Journal of Medicine, 344*(18), 1343-1350. doi:10.1056/NEJM200105033441801

ul Haq, M. A., Wong, C., Levinger, I., Srivastava, P. M., Sbaraglia, M., Toia, D., . . . Hare, D. L. (2014). Effect of exercise training on left ventricular remodeling in diabetic patients with diastolic dysfunction: Rationale and design. *Clinical Medicine Insights: Cardiology, 8*. doi:10.4137/CMC.S14089

van der Bij, A. K., Laurant, M. G., & Wensing, M. (2002). Effectiveness of physical activity interventions for older adults: A review. *American Journal of Preventive Medicine, 22*(2), 120-133.

Walker, A. E., Grimshaw, J., Johnston, M., Pitts, N., Steen, N., & Eccles, M. (2003). PRIME-process modelling in implementation research: Selecting a theoretical basis for interventions to change clinical practice. *BMC Health Services Research, 3*(1). doi:10.1186/1472-6963-3-22

Wannamethee, S. G., Shaper, A. G., & Walker, M. (2000). Physical activity and mortality in older men with diagnosed coronary heart disease. *Circulation, 102*(12), 1358-1363. doi:10.1161/01.cir.102.12.1358

Warburton, D. E., Glendhill, N., & Quinney, A. (2001). The effects of changes in musculoskeletal fitness on health. *Canadian Journal of Applied Physiology, 26*(2), 161-216. doi:10.1139/h01-012

Warburton, D. E., Nicol, C. W., & Bredin, S. S. (2006). Health benefits of physical activity: The evidence. *Canadian Medical Association Journal, 174*(6), 801-809. doi:10.1503/cmaj.051351

Wessel, T. R., Arant, C. B., Olson, M. B., Johnson, B. D., Reis, S. E., Sharaf, B. L., . . . Merz, N. B. (2004). Relationship of physical fitness vs. body mass index with coronary artery disease and cardiovascular events in women. *Journal of the American Medical Association, 292*(10), 1179-1187. doi:10.1001/jama.292.10.1179

Westcott, W. L. (2012). Resistance training is medicine: Effects of strength training on health. *Current Sports Medicine Reports, 11*(4), 209-216. doi:10.1249/JSR.0b013e31825dabb8

Williams, K. E., & Bond, M. J. (2002). The roles of self-efficacy, outcome expectancies and social support in the self-care behaviours of diabetics. *Psychology, Health & Medicine, 7*(2), 127-141. doi:10.1080/13548500120116076

Williamson, D. F., Vinicor, F., & Bowman, B. A. (2004). Primary prevention of type 2 diabetes mellitus by lifestyle intervention: Implications for health policy. *Annals of Internal Medicine, 140*(11), 951-957. doi:10.7326/0003-4819-140-11-200406010-00036

World Health Organisation. (2013). *Global action plan for the prevention and control of noncommunicable diseases 2013-2020*. Geneva, Switzerland: WHO Document Production Services.

World Health Organisation. (2018). Physical activity. Retrieved from https://www.who.int/news-room/fact-sheets/detail/physical-activity

World Medical Association. (2013). World medical association declaration of Helsinki: Ethical principles for medical research involving human subjects. *Journal of the Amercian Medical Association, 310*(20).

Zhao, G., Ford, E. S., Li, C., & Mokdad, A. H. (2008). Compliance with physical activity recommendations in US adults with diabetes. *Diabetic Medicine, 25*(2), 221-227. doi:10.1111/j.1464-5491.2007.02332.x

Zhao, G., Ford, E. S., Li, C., & Mokdad, A. H. (2011). Physical activity in US older adults with diabetes mellitus: Prevalence and correlates of meeting physical activity recommendations. *Journal of the American Geriatrics Society, 59*(1), 132-137. doi:10.1111/j.1532-5415.2010.03236.x

Appendix A: Participant Information and Consent Form (Efficacy Trial)

Austin Health

Participant Information & Consent Form
Version: 6 Date: 20 April 2011

U.R Number .....
Surname .....
Given Name(s) .....
Date of Birth .....
AFFIX PATIENT LABEL HERE

FAH018178

PARTICIPANT INFORMATION & CONSENT FORM

Study Title: **Effect of Exercise Training on Left Ventricular Remodeling in Diabetic Patients with Diastolic Dysfunction: a Pilot Study**

Principal Investigator: **Prof David L. Hare**
Senior Cardiologist, Department of Cardiology
Austin Health, Heidelberg, Australia

Associate Investigators: Dr Chiew Wong, Dr Muhammad Asrar ul Haq, Prof George Jerums, Dr Piyush Srivastava, Dr Itamar Levinger, Prof Steve Selig, Dr Francois Billaut, Ms Melissa Sbaraglia, Dr Ali Al Fiadh.

1. Introduction

You are invited to take part in this research project because you have type 2 diabetes and you have diastolic dysfunction (abnormal relaxation of the heart). This research project is aiming to study the effects of strength training exercise on heart function as we believe that muscle strengthening exercises might improve the heart function.

This study is a randomised controlled trial (RCT). A RCT is a study design that can be used to assess a new or untested intervention. It includes an intervention and a comparison group and participants are randomly assigned to each group. The intervention is given and the groups are observed to see if there is any improvement or any harm or if there is no difference between the two groups. In this way a decision can be made as to whether the new or untested intervention should be offered to patients as part of standard care.

This Participant Information and Consent Form tells you about the research project. It explains the procedures involved. Knowing what is involved will help you decide if you want to take part in the research.

Please read this information carefully. Ask questions about anything that you don't understand or want to know more about. Before deciding whether or not to take part, you might want to talk about it with a relative, friend or healthcare worker.

Participation in this research is voluntary. If you don't wish to take part, you don't have to. You will receive the best possible care whether you take part or not.

If you decide you want to take part in the research project, you will be asked to sign the consent section. By signing it you are telling us that you:

- understand what you have read;
- consent to take part in the research project;
- consent to participate in the research processes that are described;
- consent to the use of your personal and health information as described

Participant Information & Consent Form

Austin Health

Participant Information & Consent Form
Version: 6 Date: 20 April 2011

U.R Number .....
Surname .....
Given Name(s) .....
Date of Birth .....
AFFIX PATIENT LABEL HERE

FAH018178

You will be given a copy of this Participant Information and Consent Form to keep.

2. What is the purpose of this research project?

The aim of the project is to study the effects of an exercise training program on diastolic heart function. There are two phases of a heartbeat, a pumping phase (when blood is pumped out to the body) and a relaxation phase (when the heart relaxes and fills with blood getting ready for the next beat). Diastolic heart function relates to this relaxation phase of the heart beat. "Diastolic dysfunction" means the relaxation phase is abnormal.

Diastolic dysfunction or abnormal relaxation of the heart is common in older age groups and also in people with diabetes. We believe that muscle strengthening exercises may reduce damage to the blood vessels, improve the ability of the small vessels of the heart to carry blood to the heart muscle, and improve heart function. Resistance (strength) training has been shown to be safe and improve skeletal muscle strength, exercise capacity and quality of life in people with chronic heart dysfunction. We want to evaluate its specific effect on the heart during its relaxation phase, as well as the oxygen supply to the brain.

This study is a small (pilot) study that will include 20 participants. At the end of the study, if exercise training is found to be beneficial, a larger study will be carried out to explore these benefits in more detail. The results of this research may also be used by two of the associate investigators, Dr Muhammad Asrar ul Haq and Ms Melissa Sbaraglia, to obtain post-graduate degrees. Dr Muhammad Asrar ul Haq, who has a Medical Degree, five years post-graduate clinical experience and has completed the first part of his Physician training is enrolled in a DMedSc at the University of Melbourne. Ms Melissa Sbaraglia, who is an exercise physiologist with a Master of Applied Science(Exercise Rehabilitation), is enrolled in a Ph D at Victoria University.

3. What does participation in this research project involve?

If you agree to be in this study, after some initial tests, you will be randomly allocated (like the tossing of a coin) to an "exercise " group or a "stretching" group. We are doing this because the exact benefit of exercise in your situation is unknown and we want to evaluate it by comparing the two groups.

You will be asked to attend exercise or stretching sessions at the Repatriation Hospital 3 times a week for 3 months, plus 3 or 4 visits spread over 2 weeks at the beginning and 3 or 4 visits spread over 2 weeks at the end of the exercise program for tests. Each visit will last for around 1 hour.

WEEK 1 Tests	WEEK 2 Tests	WEEK 3 to WEEK 14 Exercise / Stretching Program	WEEK 15 Tests	WEEK 16 Tests
2 visits	2 visits	3 visits each week	2 visits	2 visits

Participant Information & Consent Form

Austin Health

Participant Information & Consent Form
Version: 6 Date: 20 April 2011

U.R Number .....
Surname .....
Given Name(s) .....
Date of Birth .....
AFFIX PATIENT LABEL HERE

FAH018178

Tests and Procedures

We will collect some information about your general health, medical history, medication and family history for this project and also perform the following procedures/tests:

Exercise test: An exercise test will be used to measure your exercise capacity. During this test, you will be asked to exercise as long as you can on an exercise bike. You will have sticky patches (electrodes) applied to your chest to connect you to an ECG machine that will monitor your heartbeat. Every few minutes your blood pressure will be taken and you will be asked to indicate on a chart how you are feeling. Also, you will be asked to breathe through a mask so that we can assess how efficiently your body uses oxygen during exercise.

We will also measure the amount of oxygen going to your brain during exercise. This is a simple, painless part of the test that uses sticky patches and a headband to hold a small probe in place on the left side of your forehead, above the eye. This probe is connected to a computer and through it we will be able to measure the oxygen going to your brain. .

Immediately after the exercise we will perform an echocardiogram which involves taking an ultrasound picture of the heart. The picture is obtained by pressing an ultrasound probe on the chest which transmits sound waves and collects the reflected waves to make a picture of the heart .

Depending on the results of the exercise test, we may decide to exclude you from the study if we think your heart is not suitable for the exercise training. We will discuss this with you in detail if it happens.

Body composition and bone structure: We will measure the amount of fat and muscle in your body by using a special X-ray machine called a DXA machine. This is a simple, painless procedure that involves you lying on a table for about 20 minutes whilst an x-ray machine passes over your body. It does not touch you and you normally do not need to remove clothing. This test will be carried out at the Repatriation Hospital, both at the beginning and the end of the exercise / stretching program.

Strength Tests: These tests are done twice at the beginning of the study and once at the end. The first time you do the test you will be taught the correct lifting and breathing techniques to use. The tests are carried out on gym equipment and will assess your chest strength and your leg strength by scoring the maximum load that you can lift just 1 time, but not 2 times. The total time needed to do these tests is about 15 minutes and you should recover quickly between each exercise.

Functional Tests: You will be asked to perform four tasks that represent activities of daily living: 15 metre rapid walking test, chair rise test, walking up stairs, and walking down stairs. In the 15 metre rapid walking test you will be asked to cover the distance as fast as you can but at a safe pace. In the chair rise test you will be asked to rise from a chair, walk 3 metres, and return to the chair as quickly as possible. The walking up and down stairs tests will consist of climbing up and down 20 steps as fast as possible while carrying a weight which corresponds to 10% of your body weight, but in a comfortable and safe manner. These tests take about 15 minutes to complete.

Blood tests: Both at the beginning and end of the study you will be asked to provide 20 ml (about 1 tablespoon) of blood for the testing of substances called "biomarkers". Your blood contains biomarkers or indicators of inflammation that tend to be raised in people

with conditions such as diabetes and heart disease. This study will assess whether exercise can reduce the levels of these indicators of inflammation in the blood.

As new biomarkers are likely to be discovered in the future, the blood samples will be stored indefinitely for possible testing of these in the future. Storage, testing and destruction of blood samples will be under the supervision of Prof David L. Hare. Blood samples will be stored in freezers at Austin Health and, once testing is completed, destroyed by a method in line with hospital policy at the time. The blood samples will not be used for genetic testing.

Questionnaires: We will also need your help to answer a series of questions regarding your quality of life before and after completion of the whole program. Altogether, these questionnaires will take you approximately half an hour to complete.

Muscle Biopsy (optional): Muscle biopsy is a procedure that is used to obtain small samples of muscle for testing of muscle proteins, fibre type, blood supply and enzymes. The muscle samples will be taken from your thigh muscle while you are lying on a couch. After injection of local anaesthetic, a small incision is made in the skin overlying the muscle, a biopsy needle is inserted, and a small piece of tissue (about the size of 3-4 rice grains) is removed from the muscle. During this part of the procedure you will feel pressure and this will be quite uncomfortable, but will last for only about 1-2 seconds. When the small piece of muscle is removed you may also experience a mild muscle cramp, but this only persists for a few seconds. Following the biopsy the incision will be closed using a steri-strip (like sticky tape) and covered by a transparent waterproof dressing. You will be able to carry out normal activities (including driving) straight after the procedure but should avoid strenuous exercise for 24 hours. It is common for subjects to experience some mild soreness in the muscle over the next 2-3 days, however this passes and does not restrict movement. The muscle samples are snap frozen in liquid nitrogen and stored for later testing. Once testing is completed, any remaining muscle tissue will destroyed by a method in line with hospital policy at the time.

This test is optional. If you don't want to perform this test you can still participate in the study.

Eye Examination (optional): This test will involve taking pictures of the back of your eyes (the retina) using a special camera. The photographs will be analysed for early blood vessel changes at the Centre for Eye Research Australia, 32 Gisborne Street, East Melbourne 3002. Each eye examination will take approximately 10-15 minutes. Eye drops called Tropicamide will be used to dilate the pupils before taking pictures. This medication is approved in Australia to be used for that purpose. You might be light sensitive and have blurry vision after administration of the eye drops. If you are driving yourself, you will need to wait 1-2 hours (after the procedure) for the drops to wear off before you can drive home. The hospital waiting area or the cafeteria on level 1 can be used if required.

This test is optional. If you don't want to perform this test you can still participate in the study.

Exercise program

If you are allocated to the "stretching" group, you will attend the hospital 3 times a week for 3 months to perform an exercise program that includes light gentle stretching type exercises.

If you are allocated to the "exercise" group, you will attend the hospital 3 times a week for 3 months to perform an exercise program that includes riding an exercise bike and using gym equipment to exercise the chest, back, legs and shoulders. Sessions will begin with 5 minutes warm-up followed by 50 minutes of exercise and 5 minutes of cool-down and will start at a low intensity and gradually increase to moderate intensity, depending on your capacity.

Both the stretching and the exercise programs will be conducted in small groups in a gymnasium either at Repat Hospital, Heidelberg, or Victoria University, Footscray Campus (whichever location is more convenient for you to attend), supervised by post-graduate (Ph D and Master) students trained in Exercise Rehabilitation who will design the program to suit your individual ability. Your blood pressure and blood sugar level will be monitored before and after each session and your heart rate will be monitored before, during and after each session.

4. What will happen to my test information?

After collection of the information it will be given a code, and this code will be used to identify you and your data. The code will not be easily identifiable by anyone other than the researchers. The data will be stored safely and securely in Austin Health for future related research. The data related to this project will be stored for 7 years as per Austin Health policy and then will be destroyed securely.

5. What are the possible benefits?

There will be no clear benefit to you from your participation in this research.

6. What are the possible risks?

The **exercise test** carries the risk of heart rhythm disturbance, heart attack or even death - but this risk is very small, approximately 1:10,000. The risk is minimized by having trained personnel in attendance and supervision by a doctor. Appropriate equipment and medicines are available to deal with any crises provoked by the exercise. The echocardiograms are neither risky nor particularly uncomfortable. Serious complications have not been reported with these studies, although inflation of the blood pressure cuff may cause pins and needles or arm pain, which is temporary.

There is also a possibility that the exercise might cause you to experience a low blood sugar level or "hypo". Your blood sugar level will be checked before and after the test and if you feel any symptoms while exercising the doctor will stop the test and provide you with appropriate medical treatment and follow-up.

The **body composition (DXA)** scan involves exposure to a very small amount of radiation. As part of everyday living, everyone is exposed to naturally occurring background radiation and receives a dose of about 2 millisieverts (mSv) each year. The effective dose from this study is about 0.15 mSv. At this dose level, no harmful effects of radiation have been demonstrated, as any effect is too small to measure. The risk is believed to be minimal.

Blood Tests: there are few risks related to blood taking. Participants can feel nauseated and faint at the time of blood collection, but this is a rare problem. The blood will be taken

from your arm and there is a small risk of bruising at the blood site. Rarely, there could be a minor infection or bleeding. If this happens, it can be easily treated. Trained staff will take the blood sample and sterile and disposable equipment will be used. Routine procedures that minimise risk from infections and injury will be followed.

Muscle Biopsy: there may be some pain, bruising and possible delayed soreness as a result of the muscle biopsy technique and there is a slight risk of infection. It is common for subjects to experience some mild soreness in the muscle over the next 2-3 days, however this passes and does not restrict movement. In some rare cases mild haematomas (a swelling caused by a collection of blood) have been reported, but these symptoms disappear within a week. The whole procedure will be performed under sterile conditions by a qualified medical practitioner. Although the possibility of infection and significant bruising is quite small, if by chance it does eventuate, inform us immediately and then consult your doctor.

Eye Examination: You may feel temporary discomfort in your eye during the taking of photographs due to the bright light directed into your eye. There is a very small risk of acute glaucoma (raised pressure inside the eye) after dilation of pupils with eye drops (about 1 chance in 5000), which can manifest as eye pain, redness and blurry vision immediately after maximal pupil dilation and can lead to permanent vision loss if not treated urgently. You will be monitored for these signs of acute glaucoma after dilation. Participants may be light sensitive and have blurry vision after administration of eye drops.

7. What if new information arises during this research project?

During the research project, new information about the risks and benefits of the project may become known to the researchers. If this occurs, you will be told about this new information and the researcher will discuss whether this new information affects you.

8. Can I have other treatments during this research project?

You will be asked to not commence any other exercise programs while you are enrolled in the study. You will also be asked to maintain your usual level of physical activity at home throughout the study period. This is so that we can clearly assess the effects of our exercise program.

It is important to tell your doctor and the research staff about any treatments or medications you may be taking, including over-the-counter medications, vitamins or herbal remedies, acupuncture or other alternative treatments. You should also tell your doctor about any changes to these during your participation in the research.

9. Do I have to take part in this research project?

Participation in any research project is voluntary. If you do not wish to take part you don't have to. If you decide to take part and later change your mind, you are free to withdraw from the project at any stage.

Your decision whether to take part or not to take part, or to take part and then withdraw, will not affect your routine treatment or relation with your doctor.

Austin Health

Participant Information & Consent Form
Version: 6 Date: 20 April 2011

U.R Number .....
Surname .....
Given Name(s) .....
Date of Birth .....
AFFIX PATIENT LABEL HERE

FAH018170

10. What if I withdraw from this research project?

If you decide to withdraw, please notify a member of the research team before you withdraw. This notice will allow that person or the research supervisor to inform you if there are any health risks or special requirements linked to withdrawing.

11. How will I be informed of the results of this research project?

If you are interested in the results of the project, we can provide you with the verbal information as well as a copy of the final article whether or not published.

12. What else do I need to know?

What will happen to information about me?

Any information obtained in connection with this project and that can identify you will remain confidential. It will only be disclosed with your permission, except as required by law. Information collected will be stored securely for 7 years as per Austin Health policy and then will be destroyed securely.

In any publication, information will be provided in such a way that you cannot be identified.

It is desirable that your local doctor be advised of your decision to participate in this research project. By signing the consent section, you agree to your local doctor being notified of your decision to participate in this research project. Information about your participation in this research project may be recorded in your health records

How can I access my information?

In accordance with relevant Australian and/or Victorian privacy and other relevant laws, you have the right to access the information collected and stored by the researchers about you. You also have the right to request that any information, with which you disagree, be corrected. Please contact one of the researchers named at the end of this document if you would like to access your information.

What happens if I am injured as a result of participating in this research project?

If you suffer an injury as a result of participating in this research project, hospital care and treatment will be provided by the public health service at no extra cost to you if you elect to be treated as a public patient.

Is this research project approved?

The ethical aspects of this research project have been approved by the Human Research Ethics Committee of Austin Health.

This project will be carried out according to the *National Statement on Ethical Conduct in Human Research* (2007) produced by the National Health and Medical Research Council of Australia. This statement has been developed to protect the interests of people who agree to participate in human research studies.

13. Who can I contact?

Participant Information & Consent Form

Austin Health

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U.R Number .....
Surname .....
Given Name(s) .....
Date of Birth .....
AFFIX PATIENT LABEL HERE

FAH018170

For complaints:

If you wish to contact someone, independent of the study, about ethical issues or your rights or to make a complaint, you may contact:

Ms Jill Davis

Manager, Austin Health Research Ethics Unit

Telephone 9496 4034

If you want any further information concerning this project or if you have any medical problems which may be related to your involvement in the project (for example, any side effects), you can contact the principal researcher Professor David Hare on 0394965000 or any of the following people:
Dr M Asrar ul Haq, Cardiology Research, Austin Health, 0394965000
Dr Chiew Wong, Department of Cardiology, Austin Health, 0394965000
Professor George Jerums, Department of Endocrinology, Austin Health, 0394965000
Dr Piyush Srivastava, Department of Cardiology, Austin Health, 0394965000
Dr Itamar Levinger, Cardiology Research, Austin Health, 0394965000
Professor Steve Selig, Cardiology Research, Austin Health, 0394965000

For further information or appointments:

Deidre Toia
Research Coordinator, Department of Cardiology, Austin Health
Tel: 03 9496 3652 Email: deidre.toia@austin.org.au

Participant Information & Consent Form

Austin Health

Participant Information & Consent Form
Version: 6 Date: 20 April 2011

U.R Number .....
Surname .....
Given Name(s) .....
Date of Birth .....
AFFIX PATIENT LABEL HERE

FAH018178

CONSENT FORM

I, ...have been invited to participate in the above study which is being conducted under the direction of Prof David L.Hare. I understand that while the study will be under his supervision, other relevant and appropriate persons may assist or act on his behalf.

My consent is based on the understanding that the study involves:
1. The procedures as explained on pages 2 to 3 of this document
2. An OPTONAL muscle biopsy as described on page 4
3. An OPTONAL eye examination as described on page 4.

Please circle one option for each of the procedures below:

1. I CONSENT / DO NOT CONSENT to the muscle biopsy procedure.

2. I CONSENT / DO NOT CONSENT to the eye examination procedure.

The study may involve risks, inconvenience and discomforts, which have been explained to me and which are listed on pages 5 to 6 of this document.

- I have read this 'Participant Information and Consent Form' and understand the general purposes, methods and demands of the study. All of my questions have been answered to my satisfaction.
- I understand that the project may not be of direct benefit to me.
- I can withdraw or be withdrawn by the Principal Investigator from this study at any time, without prejudicing my further management.
- I consent to the publishing of results from this study provided my identity is not revealed.
- I hereby voluntarily consent and offer to take part in this study.

Signature (Participant)	Date:	Time:
Witness to signature	Date:	Time:
Signature (Investigator)	Date:	Time:

Participant Information & Consent Form

Appendix B: Information to Participants (Qualitative Interview)

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH

You are invited to participate

You are invited to participate in a research project entitled "Self reported experiences of an exercise intervention and quality of life in people with type 2 diabetes".

This project is being conducted by a student researcher Melissa Sbaraglia as part of a PhD study at Victoria University under the supervision of Associate Professor Harriet Speed from the School of Sport and Exercise Science.

Project explanation

This study involves one-on-one interviews in which participants will be given opportunities to "tell their stories" – their experiences of diabetes and exercise, their interpretations and understandings of those experiences and their perceptions of how these experiences have influenced (positively or negatively) their lives and the ways in which they cope with the limitations imposed on them by diabetes.

What will I be asked to do?

Participation in this research will involve you engaging in a one-on-one interview with the student researcher. The interview is expected to last approximately one hour and can be face-to-face with the researcher or by phone. With your permission, the interview will be audio-taped so as to assist in recording and analysing the information you provide.

The interviews will consist largely of an open-ended dialogue between you and the student researcher that focuses on your experiences of diabetes and the exercise training intervention you participated in at Austin Health, your interpretations and understandings of those experiences, your perceptions of how these experiences have influenced (positively or negatively) your life and the ways in which you cope with the limitations imposed on you by diabetes.

There are no right or wrong responses in the interview and you will be able to choose not to respond to a particular issue or stop the interview at any time. Participation is entirely voluntary and you are free to withdraw your consent to participate at any time without the need for a reason and without any consequences.

What will I gain from participating?

Undertaking the interview may not provide any benefits to you, but for some people, the opportunity to openly and confidentially discuss issues relating to their diabetes, in general, may be a positive experience that is rewarding in itself.

How will the information I give be used?

The audio-taped information you provide in the interview will be transcribed to a hard-copy (paper copy) and then analysed by both members of the research team. The transcript of your interview will use a pseudonym in place of your name so as to ensure confidentiality of your identity and the responses you give in the interview.

The analysed interview data will then be pooled with the analysed data of other participants in the research, and presented in the student researcher's thesis and may be published in scientific journals and conference presentations. No personally identifying information will be included to further ensure that your participation in the research and interview responses remain confidential and known only to the researchers.

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

Signed:

Date:

Any queries about your participation in this project may be directed to the principal researcher
A/Prof Harriet Speed
Phone: (03) 9919 5412

If you have any queries or complaints about the way you have been treated, you may contact the Research Ethics and Biosafety Manager, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 or phone (03) 9919 4148.

Appendix C: Consent Form (Qualitative Interview)

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

CONSENT FORM FOR PARTICIPANTS INVOLVED IN RESEARCH

INFORMATION TO PARTICIPANTS:
We would like to invite you to be a part of a study into…

The experiences of an exercise intervention and quality of life in people with type 2 diabetes mellitus. A one-on-one interview will be conducted and will focus on your interpretations and understandings of your exercise experience in the pilot clinical trial at Austin Health, your perceptions of how these experiences have influenced (positively or negatively) your life and the ways in which you cope with the limitations imposed on you by diabetes.

CERTIFICATION BY SUBJECT

I, _____
[Participant's name]

of _____
[Participant's suburb]

certify that I am at least 18 years old and that I am voluntarily giving my consent to participate in the study:
"Self reported experiences of an exercise intervention and quality of life in people with type 2 diabetes" being conducted at Victoria University by: A/Prof Harriet Speed.

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the research, have been fully explained to me by:

Ms Melissa Sbaraglia (student researcher)

and that I freely consent to participation involving the below mentioned procedures:

- A one-on-one interview, either face-to-face on via phone with the student researcher
- The interview is expected to take approximately one hour to complete
- In the interview, you will be asked questions relating to your experiences of diabetes and the exercise training intervention you participated in at Austin Health, your interpretations and understandings of those experiences, your perceptions of how these experiences have influenced (positively or negatively) your life and the ways in which you cope with the limitations imposed on you by diabetes.
- Information that you provide during the interview will be treated as strictly confidential and no identifying information about you will be made available to anyone outside of the research team
- Your interview transcript will be given a pseudonym to protect your identity

Please tick:

☐ I agree to the interview being audio-taped

☐ I do not agree to the interview being audio-taped

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

Signed:

Date:

Any queries about your participation in this project may be directed to the principal researcher
A/Prof Harriet Speed
Phone: (03) 9919 5412

If you have any queries or complaints about the way you have been treated, you may contact the Research Ethics and Biosafety Manager, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 or phone (03) 9919 4148.

Appendix D: Qualitative Interview Guide

INTERVIEW GUIDE

Introduction (10 minutes)

1. Welcome

2. Overview – purpose of interview; discuss structure of interview

3. Confidentiality – how will data be used; your identity and data will be protected by using a pseudonym and treated confidentially

4. Consent –

- There are no right or wrong answers
- You can choose not to answer a particular question
- You can pause or stop the interview at any time
- Questions?
- Permission to use audiotape

Discussion (40 minutes)

Part 1 – use answers from SF36 & CDS to probe quality of life before, during and after study for each subscale

- General Health
- Physical Health
- Mental Health
- Social Functioning
- Bodily Pain and Sleep

Part 2 – exercise habits, attitudes and beliefs before, during and after study

- Barriers
- Self-efficacy

Closing (10 minutes)

1. Comments, questions?
2. Debrief
3. Permission to contact for more information if needed
4. Thank you

Appendix E: Theoretical Domains Framework

Table E1. Participant Exemplar Quotes for Represented TDF Domains

Skills
A bit of structure and once again, I go back to the challenge. The challenge being: one - get out of bed; two - being told what to do.... And the exercise, because I was doing the exercise, I was feeling 100% better. It encouraged me to eat better. Yeah, I had structure to do healthy things. (Nate) I've learnt that there are a lot of good exercises that can work different parts of the body. I guess when you're doing sit ups I learnt that it's slow, you don't have to go fast. You have to feel the muscle moving. Um I also learnt a lot about breathing that I didn't know. You breathe in slowly and out slowly when exercising. You breathe out with the effort. I guess I applied those skills to the gym. I just learnt that different exercises work different muscles. To focus on those muscles to work those muscles because you can use the wrong one's if you're not aware what the exercise is for. Yeah I did learn a lot from coming in here, a lot of skills I was able to transfer over to the new gym. (Brenda) I really wanted to exercise but I really didn't know where to start. Gyms and that were unfamiliar places I'd never been. (Brenda) I like to go slow because I'm trying to get the technique and the learning from it. And they'll tell me that, they'll explain while I'm doing why we're doing it what should be happening to my muscles. You know, are you feeling it here? So I like the fact that they're always explaining the (right) way of doing the exercise. (Ruth)
Social/Professional Role and Identity
[Without VU] I'd still go to the gym. As I did when I was told not to exercise anymore. Yeah, I don't need that [VU anymore]. But I feel I'm repaying VU for what my relationship has given me. I'm just maintaining that because it's where it all started. That way I feel I'm paying back. Being involved with the research and being available for the students. I say to the students, "When you look at me, what you see is VU, a consequence of VU. Because that's where it all started. Even coming here [repat] it's all VU. You guys are running it. And that's it. I've got biceps, triceps, shoulders. (Nate) I've maintained my relationship with Victoria University. I finished here as you know, and was offered a position at the Cardio Club at VU. Last year I was offered an extra two days a week to help out as a volunteer for the students. (Nate) Plus, I believe strongly in participating in research. I think the more people who participate in research the better off society will be. (Claire) And I strongly believe in research and contributing back to my society and my community. If it comes up gain I'd be perfectly happy to contribute. It's the same reason you give blood isn't it? You attend functions and you go to fetes it's all about that giving back to your community. You know, if me being involved in this study helps one other person then it's great. (Claire) I find that there's always been obstacles along the way to stop you from going to the gym. There's always things that pop up that prevent you from doing daily exercise. I guess with me, I've got a big family so there's always things going on with the children. My daughter with Down

Syndrome has a lot of health issues so I have to address those. That takes a chunk of time out of your days. She has a lot of visits to the Children's Hospital so that sort of takes a whole day. And that restricts me from going to the gym. And just busy family life I guess, because I've got other children as well. I've got a mother who's not well as well and I've been trying to attend to her as well. I guess these things prevent me from doing daily exercise. Before you know it a whole month has gone by and you haven't done any exercise. You know, it is hard. I guess family commitments really prevent you from living the way you prefer to live. You're not free when you've got a family. It's different. I just can't say I'm going to go to the gym every day at this time, because things pop up. (Brenda, barrier)

I prefer to (exercise) here (at VU with the students) because I actually like the fact that I'm giving them their hours, makes me feel useful and by the same token I get something useful out of it. (Ruth)

I've tried to encourage my friends to be involved in a few more of these (exercise studies/programs). I've got other people who have been in hospital for four months, and four months is a long time to be in hospital. They've been too scared to go through physical therapy and rehabilitation and I've just been trying to encourage them to participate…to get up and do it, because they don't push you more than they need to. You know, it's always doable, always. (Ruth)

I do ask (the students) about their lives because I'm interested, I'm a people person and I feel as if they're interested in me. So we have that good rapport. But in the same token I'm interested in how they're going with it, because I teach…I'm a teacher...Student X in particular. He's so friendly, professional, so young, but quiet. He's not a pushy, pushy person but he's always like, "how are you going with it, do you want to go a little bit tougher today?" Always encouraging you to better yourself, but not pushing you. If you're feeling sore or tired he'll say "we'll just take it a little bit easier today, we'll just do 10 of those today rather 15." Always modifying (the exercise) to suit me, which makes you feel cared for. So I'm hoping they get the same thing back. Because I hope they get their hours and I hope they get what they want out of their lives. (Ruth)

One of the things I like to think I bring to it is I'm usually fairly regular. I know a lot of (clients) let them down. A lot of the clients don't turn up. And a lot of them don't just come from 5 minutes away. You know, like A comes from Bacchus Marsh, B comes from Mornington, C comes from Macedon. We're talking some kilometres. And there would be nothing worse than getting here and finding out that the client has cancelled. So I like to think that I'm a regular. (Ruth)

Yes, I like to feel that I am useful and needed, that's a huge part of who I am. I like to share knowledge. I think that's part of the teacher in me. And for me doing it these students are learning about diabetes. And they're learning about people with sore hips, sore knees and sore shoulders. And they're learning how to help these people do better. So I like that. So yeah, I think that wanting to help is part of it. The knowledge sharing is part of it. And I learn from them too. (Ruth)

And honestly I think it's a two way street. You guys need stuff for the study and us guys need the exercise. We need people to look at us, with diabetes and with heart problems and look at us and you get your facts and figures and we get the help. (Ruth)

Beliefs about Capabilities
[Without VU] I'd still go to the gym. As I did when I was told not to exercise anymore. Yeah, I don't need that [VU anymore]. (Nate)
Once I was offered the opportunity to do more exercises and then onto weights and stuff like that it all improved. I don't need those appliances (to put socks on and pick things up from the floor). (Nate)
Like just yesterday at the uni, the kids had me running up three flights of stairs. I ran up them and walked down them. Before I did your stretching, and my involvement with VU, I required the rail to go up and down stairs. I avoided stairs, I wasn't confident because of my knees and everything. When I was running yesterday, I thought, this is good mate. I was at a 15 on the Borg Scale at the end. I still reckon I could've done another one or two. (Nate)
I don't need this [study] anymore, I don't need to come but I did like coming. So the want is still there. Beforehand it was both the need and the want. Now I don't need to, I have other outlets. There have been a lot of changes in my life since I first (started coming here). So I don't need to come here anymore. (Claire)
I'd given up because of the fact that with the health issues there was so many of them. I think I almost started to give up on it all. And having the opportunity to do this was that jump start. It originated at the same time I started doing the weight clinic downstairs and having some negative responses. I was feeling just what's the point? What's the point of it all? I'm going to die anyway. But I don't feel like that anymore. (Claire)
I would have said (high intensity exercise) is too hard for somebody like me. The study made me realise that it's not. (Ruth)
The stretching was a good way of getting me used to coming in three times a week. It was a really good way of getting me into the routine without physically hurting me. I've got more confidence with exercise since then and that's because I've learnt that they never give you too much. They always give you something that's doable. They don't get you to run a marathon if you can't walk six hundred yards. So that's one of the things that I've liked about this, everything that they've ever given me is doable at the time. So if you had have said to me, "go and leg press 157kg 20 times" I would have said, "no". But if you said it to me now I'd give it a go. So it's just helped me prepare over time. So I think it was good preparation. (Ruth)
So ever since (baseline testing), even through the exercise, I kept on increasing weights. Until finishing with the leg extension…which is something I never thought I would do…but I got to 100kg. (David)
But I find them all (exercises) quite pleasant and the biggest thing…(it) was achievable. (David)
I was surprised because whatever it was…say 10 seconds up a flight of steps and I wasn't really puffed out at the end of it. So I found it was pleasant. In fact I was looking forward to see what challenge you got for me…and that was the interesting part. I kept on beating it all the time. It was a definite personal challenge. (David)
I thought frankly at times…there were other people here riding the bike beside me, not going anywhere near the speed I was…and they were obviously younger than I. So I decided I was fit…I was reasonably fit…the whole way through. (David)

Beliefs about Consequences
Diabetes, mental state and physical state. The possibility of problems with my eyes. The problem with limb loss all those sorts of things associated with the diabetes. I wanted to avoid those. (Nate)
But as a result of everything that's happened...changing lifesyle, eating, don't drink, all those things I think have a bearing on the fact that, definitely exercise and good eating has had a bearing on not requiring to take medication. (Nate)
After the exercise I was feeling fatigued and that helped me sleep. Whereas before, say the grog would've been the sleep. (Nate)
See, even now if I broke a leg and had to lie in bed (because I couldn't exercise) then I'd be back on medication, so that's the nervousness. (Nate)
Yeah (the heavy exercise) helped. At that point, getting into that particular period was when my medication was being reduced. So it was obviously helping. (Nate)
But I believe that if I don't keep doing what I'm doing now, the diabetes will come back and regress back to what I was...giving up, back to alcohol. There's always a chance you'll go back to it. And that's going back to the old days which I don't want. (Nate)
So when I was told that being part of this study would (1) be a way of looking at my diabetes because it was regular checks and (2) reintroducing through a local gym, introducing regular exercise I jumped at the chance and was glad I did. (Claire)
I just want to reiterate that holistic focus on health is more important than focusing on the one thing at a time. Exercise and the social or mental health side of things are just are big components to managing health as the diet, or taking the drugs. (Claire)
I really wanted to improve my blood sugars. I knew that the medication really wasn't working on it's on. So that's why I decided to join at the time. (Brenda)
I felt that I needed to exercise. It was important and I hadn't done any. So it would be a good learning experience. Just to learn what I need to do. I really wanted to improve my blood sugars. I knew that the medication really wasn't working on it's on. So that's why I decided to join at the time. (Brenda)
Before the study I was struggling. I just couldn't do anything really (to improve my blood sugars). I just couldn't make improvements. I just felt (my diabetes) is spiralling out of control. So that's why I said look I'll do the (exercise) program. (Brenda)
(When you exercise) you just feel like you're doing something positive, moving forward, rather than staying the status quo, staying the same. You just want to be a healthy weight, healthy blood sugars, just have more control. More control in your life. And I think that it's possible. At age 50 it's possible, I think. There's a window for improvement. (Brenda)
I'm in a bit of a low at the moment because I haven't been going to the gym. I just feel that that tiredness has come back. I've noticed a difference, that tiredness and feeling lethargic has come back. (Brenda)
And I don't think exercise would ever be detrimental and that's something else I found too. Like, my husband said "be careful, don't overdo it." I said to him, they don't push you to that extent. It's not like you've got someone yelling at you, not like that Biggest Loser when they're

in your face. It's not like that. It's encouraging, it's always doable. Yeah they encourage you to do better than what you did the time before, but it's not like they push you to extremes or put your body at risk. (Ruth)
If someone was scared or hesitant, the stretching would be a very good way of leading them into an exercise program. You know just coming in and stretching for an hour, everybody can do that. (Ruth)
I'd hate to imagine what my blood sugar would be without (exercise). I reckon I would have been on the (insulin) needle by now, if I wasn't doing that exercise program. I think it's definitely helped because it brings it down. (Ruth)
My cholesterol improved so much she (the doctor) took me off the tablets for a while. That was great. My cholesterol used to be eight. It's 4.3 now. (Ruth)
I'd say my flexibility was better (after the 3 months of stretching). Especially my knees. (Ruth)
I have bowel adhesions. So I have a lot of pain. So between the bowel adhesions and the running to the toilet all the time the pain just never stops. So I was on pain killers all the time. With the exercise I've had a lot less of the painkillers and I think it's because of the exercise it's really helped. (Ruth)
Yes, (exercise) definitely helps with IBS. I think it just makes you feel better in yourself. Like before if I wanted to go out at nine o'clock in the morning I would have to get up at five o'clock so I could go to the toilet and get all the shitting out of the road before I could go anywhere. Now I don't have to do that. (Ruth)
The exercise has helped my blood pressure…absolutely fantastic on blood pressure. I'm on Avapro (anti-hypertensive medication) and I'm expecting to see that go down. (Ruth)
Exercise on its own doesn't affect the sugar. It affects the sugar for the session. But the minute you walk away from it, the next time you have something to eat you may as well go back into the gym. It's only as good as the exercise session you've just done. Soon as you eat something, bang. It's straight back to square one again. Although as I said the impact of the exercise is that I get the fuzzies much lower. So that's been good, I've felt the exercise has made it become more normal. But that was before all the mucking around with this medication. Since we've been mucking around with the medication nothings been right. Thank goodness I've been exercising all the way through. I hate to imagine what it would be. (Ruth)
My benefit was I wasn't degrading…my status quo was being kept. I stayed on the plateau. I didn't go down hill. (David)
I'd been to Germany...And their short walk is a minimum of two kilometres. And things like going to the Nymphenburg Palace…I estimated I had done seven kilometres walking from gate to gate…that's the extent of the place…and at the end of the day I was not the least bit tired. So again, my comment was "it's your fault putting me through all those exercises." (David)

Reinforcement
I have no trouble getting there but some days you feel oh I won't worry about doing that today. Then I think if I don't do it today then it's going to be harder to do tomorrow, so I'll do it today. (Nate) But I feel I'm repaying VU for what my relationship has given me. I'm just maintaining that because that's where it all started. That way I feel I'm paying back. Being involved with the research and being available for the students. I say to the students, "When you look at me, what you see is VU, a consequence of VU. Because that's where it started. Even coming here [repat] it's all VU. You guys are running it. And that's it. I've got biceps, triceps, shoulders. (Nate) I was noticing that my (blood sugar) levels were coming down. So much so, that there was even a question as to whether I was diabetic or not because my (blood sugar) levels were in the realm of 7 and 8. (Claire) I do believe that the exercise was more a contributing factor to that than anything else. Including the fact that I would park all the way across the road, I would walk briskly here at 7 o'clock in the morning, and walk up the stairs and come in here and immediately start doing my exercise. I found that that whole cloginess that prevented me from being able to do some stuff had lifted. Not entirely because I've still got a lot of weight. But it removed that first barrier and I started feeling a lot better. I was able to move faster and walk up the stairs. I could actually walk up the stairs without having to stop to catch my breath by the end of the whole lot of studies. That to me was one of the biggest things, being able to walk up stairs without puffing. (Claire) I haven't experienced restless leg for over a few years now. I think it's a combination of being exercising and having a bed that I can change. I think that it's a lot because of the exercise as well. (Claire) You're able to get to sleep if you've been exercising. And I know that when I've had an exercise day...like Friday night I did Zumba...I got into bed and even before I put myself into the right position I was asleep. I though oh my god that's amazing because there's nothing worse than tossing and turning and trying to get to sleep. (Claire) When the study finished here I was waiting for Watermark in Greensborough to open. There was a gap where I didn't have the exercise. It was really obvious there by not doing exercise that I should be doing exercise. Because I felt so much better and my (blood sugar) levels were lower. My just general, whole feeling towards life was better. I started finding that I was becoming sluggish and less motivated, less likely to make good decisions. (Claire) It kept [blood sugar levels] constant, at a good level. I could say that there was definitely an effect because there was a period in there when I took some leave. I think I might have gone to Adelaide for a week or so or there was a 2 week break. And I noticed an effect on my sugar levels and my overall feeling of health. I was feeling quite lethargic not coming. I started to really miss coming to the gym. (Claire) Yes, that was because you did constant checks on me and reassured me as well...Every time I came in, you checked and compared, and you told me, "you're fine, you're on track." (Claire) I think that exercise flushes all that crap out of your system as well. I wasn't feeling so revolting. I wasn't feeling so negative. It was making

me more positive. I was feeling better. When you're doing exercise it's not just about increasing the heart and making your blood pump, which I think is important. Because when you sit for too long your blood just pools and sits there. I don't think it gets to clear itself as quickly, so its full of toxins. By doing the exercises the pumping was making everything work really fast and better and I was getting rid of the toxins. (Claire)

But I was strengthening parts of my body. I don't like to feel weak. When you're lethargic...I get really upset if I feel lethargic. Because I was having oxygen running through my body and clean blood and my muscles were feeling good. Stuff like that, just the fact that you sit up like that is good for you. It makes you smile. (Claire)

I feel sluggish if I don't exercise and if I'm not watching my diet. (Claire)

It's good for your diabetes, it's good for your wellbeing, it's good for your mental health. It just makes you feel good. You just feel like you've got a lot more energy afterwards...if you make that effort you really do get the rewards. (Brenda)

You see results in terms of weight loss and your fitness. Because I've noticed when I stopped for a month or so, when I go back I'm not so out of breath. I'm not struggling. I think I must be fitter if I can go back and pick just up where I've left off. (Brenda)

But with the exercise you know that it's doing something good for your body, it's helping with your diabetes; it really lowers your blood sugars. If I go to the gym with high blood sugar, when I leave after an hour it's probably come down from 14 to 9, it comes down a good 5 units. It makes a huge difference. (Brenda)

I was coming in with high blood sugars. And testing at the end (of the exercise session)...it was dramatically lower, 14 down to 9, or 12 down to 7. (Brenda)

I lost probably 5 or 6 kilos during the first period at the gym on my own. I was 81kg and I went down to 76kg. (Brenda)

I was hoping to get the exercise (intervention group), but I didn't, I got the stretching. And I thought oh well they said I'll get the exercise when it's finished, that's fine I'll just do that. So I approached the stretching with a good attitude and I think that helped. (Ruth)

The only time I get readings under 10 is in the exercise program. So I'll start off above 10, quite often 12 or 13 or 14. If I go over 15 they won't let me do exercise. The only time it goes under 10 is after exercise. (Ruth)

When I finished the stretching program, my blood pressure then was around about 170/96. With one lot of exercise program (first 3 months) it went down to 150/90 which I was quite pleased with. Now they've brought in supersets in the exercise program and now its 135/75. So that's where I'm at now. So with my blood pressure I'm really, really happy. (Ruth)

So the exercise has made such a difference to that side of things - to my cholesterol and to my blood pressure - that it's just amazing. (Ruth)

I'm probably sleeping 6 to 7 hours at the moment. I still get up and go to the toilet every 2 hours, but I sleep well. It was between 4 and 5 hours a night. The exercise has definitely helped me there. Even if I get up I can go back to sleep. I have no trouble going back to sleep at all. So exercise has really helped there. (Ruth)

What I can leg press now and what I could leg press before are two totally different things. I can't remember the beginning I think it was around 50kg or 60kg. I'm leg pressing three lots of 15 at 105kg now. I'm about to go to 107.5kg. And (during testing) I can max out the

machine at 157kg for 20 repetitions. (Ruth) Definitely got quicker with the 6 minute walk. I got my first time under the five minutes for the distance. I know I've got the longer distance in the same time. Definitely got quicker and stronger. (Ruth) I've hardly lost any weight I'm probably the same weight I would have been for your study. But I've definitely lost inches. So I'm quite happy with where I am at the moment. (Ruth) They do my sugar before and after, if my sugar is playing up or if I get light headed they'll do my sugar in between as well. And we've learnt now, I used to get light headed around seven and a half and now I get light headed around fur and a half/five. So I think the exercise has actually helped my body cope with the sugar better. I don't know if that makes sense. But you know what I mean, before my body would go funny as soon as the sugar started to go down. Now it can go a lot lower. So the exercise has made a big difference there. (Ruth) I see the results in my blood pressure. Every time they take it, it's like "yes!" Like I walk in and they take it 135/72… yep. I used to be 170/96…hey 135…yay! Yes, you know I used to be 120/70 until I got diabetes. Once I got diabetes, up went the blood pressure. I actually think the exercising is bringing the blood pressure back under my control. (Ruth) But whilst here you took my blood sugar levels before and after…sometimes it had gone down as much as 3.0…which just shows us that we must have been doing some work to get rid of the thing. (David) Me being me asked if I could have copies (of the results) so I could put figures onto a spreadsheet. I saw them with interest and thought to graph the results, which I did. And you could see the climb going steadily higher and higher on the page. (David) I had a look at my quadriceps…well when I started I'd say they were two inches wide…when I finished the last one they were about four inches wide. So I obviously put on muscle bulk or whatever you call it. So I think I got great benefit out of it and probably now some 12 months later I still feel physically fit. (David)
Intentions
It's just a matter of doing it, just accepting it as a part of life. (Nate) But I believe that if I don't keep doing what I'm doing now, the diabetes will come back and regress back to what I was...giving up, back to alcohol. There's always a chance you'll go back to it. And that's going back to the old days which I don't want. (Nate) At that time (during the stretching) the seed was planted for change, put it that way. There was something definitely happening but I wasn't aware (of it at the time). (Nate) Then the exercise thing was something that I wasn't doing which I'd done all my military career for over 23 years. So I thought well I'll get back into that. I was going to the gym at the Repat Hospital for veterans. (Nate) I happened to look at the notice board at the Austin…saw this study and I debated for a couple of weeks…and I thought I couldn't see that there was any loss to me and I would probably benefit out of it. So I volunteered. (David) I was about 81 years old when I started to think it was getting a bit much standing on my feet all that time…and absolutely non stop from

10am to 3pm. And now that I was free I had time to go and find out more about this exercise. I found it was two or times a week and I could fit that in around my other appointments. (David) In the future, perhaps. If the muscles start to harden up or something like that. If the doctor suggests it or I might suggest it to the doctor. See if they think it's safe enough for me to embark on such ventures, then I'll do it. (David) A couple of times I've thought…should I go to the local health joint (gym)? I've made enquiries and I've found they like to have you go in on the same days at the same time each week. And that's a bit hard with the things I'm already doing. It's something they want me to do, rather than it being what I want to do. I met yet take it up. (David)
Goals
That was my aim. To come off the medication and it was, it felt great. I don't like taking drugs of any sort. I don't like having them in my body. (Nate) (Exercise is) the be all and end all. Exercise encourages you to eat better so you can perform the exercises. That's my whole life now. To be healthy. To out live me kids. I'll do it too. (Nate) I'm aiming to take my life now...back to my youth when I was in my early thirties...[reflecting on being fit in the army]...That's what I'm like now with wanting to maintain the health and get back to that physical peak. (Nate) I've just stuck with it. I've been encouraged to do it. It's just a matter of doing it, just accepting it as part of life. Ah look, I'm retired. I don't have to go to work. So, it takes me less than 10 minutes to get to the gym from my home. That 35 to 45 minutes in the gym. Then, say, 10 minutes to get home again. That's my days work. That's what I put it down to. I had eight hours to do it before, now I do it in an hour an a half. That's not hard to do. (Nate) Now I do cardio club…pretty extensive and exhaustive. I also do anywhere between four to five days at the Greensborough gym. I do cardio and weights. Like this morning, because I exercised yesterday at VU, this morning I went in and I did 6 minutes on the rowing machine high intensity. Six minutes on the elliptical trainer. Fifteen minutes seated bike and a couple of shoulder exercises that I felt I needed to do. I do an average of thirty to fourty five minutes at Greensborough. (Nate) That gave me a personal health assessment. He did a health plan which was a series of questions on where you want to go, graphed. Why you wanted to join the gym and what parts of your life it affected. Because if you were a gym junkie they focused on more of the gym stuff. Because mine was more about becoming fit and getting moving they said they were very highly supportive of doing the classes as well as the gym work. So I got a program set up. I got a taggy thing. It's all done by key now. So your program is actually in a key. They give you a key when you come in. You lock your key in and its loads your information on each peice of equipment. You lock your key into it and it tells yous ok put the weight onto 114kg and do 10. And it makes you wait for one minute until it lets you do the next one. It's really good in that respect. (Claire) I really wanted to improve my blood sugars. I knew that the medication really wasn't working on it's on. So that's why I decided to join at the

time. (Brenda) My goal is to manage my sugar and get rid of that. (Ruth) I am rapt that the blood pressure medication has come down once and it will go down by Christmas. It's going to go down to a lower strength by Christmas so I feel as if I'm doing something at least proactive to work on my goals. (Ruth) I think if I keep (the exercise) going I can foresee 125/70. I can. It's a goal and I will get it. (Ruth)
Memory, Attention & Decision Processes
It was something that I really enjoy, I look forward to it. I don't even have to set an alarm clock to get out of bed to go and make my appointment at the gym and so forth. (Nate) At that point getting into that particular period was when my medication was being reduced. So it was obviously helping. It brought me back, took me back to when I was fit in the army. (Nate) I'm aiming to take my life now...back to my youth when I was in my early thirties...[reflecting on being fit in the army]...That's what I'm like now with wanting to maintain the health and get back to that physical peak. (Nate)
Environmental Context and Resources
Then the exercise thing was something that I wasn't doing which I'd done all my military career for over 23 years. So I thought well I'll get back into that. I was going to the gym at Repat Hospital for veterans. It was hard to get on machines and all that sort of stuff. I said I need something a little bit more structured, not laissez faire. (Nate; Barrier) Pain was in my lower back, shoulders and joints. Particular my knees, because of knee injuries...arthritis...ankles because they were carrying the extra weight, yeah all those things. It was very restricting and I lacked confidence in movement. I didn't want to move too much at all. I even had physiotherapy via the Repat come out to home and assess me. I needed an appliance to assist me put socks on. I needed a picker thing extender to pick things up from the floor if I dropped them. That was the extent before the exercises. (Nate; Barrier) I got a program set up. I got a taggy thing. It's all done by key now. So your program is actually in a key. They give you a key when you come in. You lock your key in and its loads your information on each peice of equipment. You lock your key into it and it tells yous ok put the weight onto 114kg and do 10. And it makes you wait for one minute until it lets you do the next one. It's really good in that respect. I've got the machines you can plug your headphones into the TV screen there and you can change the channel. You can play Marjong. You can go online and check the internet. I can't do that though. I can't exercise and do the internet at the same time. I can watch the TV though, the morning news. A couple of times I've gone after work and I've been able to watch general TV programs. (Claire) Watermark opened in September of last year. I joined up before it opened, so I got a foundation (cheaper/affordable) membership. (Claire) Probably the wait to use some of the equipment was the only (negative) thing (in the research gym), sometimes you'd have to wait. Because when I had to wait I had to listen to that annoying man. (Claire, barrier) I had stopped going to the gym because of financial reasons. They were becoming more and more expensive. I'd been at Fernwood for quite a

few years and then they charged me too much so I stopped going. (Claire, barrier) I liked the fact that it gave me an opportunity to reintroduce the gym back into my life. Especially because I couldn't afford it. I actually couldn't afford Fernwood's prices anymore. There wasn't another gym that was close enough to me that would allow me to afford it. It was really quite expensive. (Claire, barrier) Except for when there was too many people in here. I hated having to wait because I was going off to work. There was a few people here who didn't work. I'd be very selfish and think, "Why couldn't you come in later? When those of us who have to go to work have come and gone. Why do you have to come in now and take up space?" But you know, that was just me being selfish. (Claire) My gym times are limited also. I can't really go in the evenings or early in the morning – it's restricted between 9 and 3. (Brenda, barrier) I should be walking more as well, I know that. I should do that when I don't go to the gym. I reckon I should be walking. And then they scare you, don't walk alone at night [laughs]. My husband scares me, my kids. This world's scary now, we can't go walking by ourselves [sigh] it's not good. And my husband doesn't come with me, he's a workaholic. (Brenda, barrier) I had a look around the gym and I found they do not have a leg press machine like this one; it's a different horizontal sort of a thing. The chest press they had, they didn't have the leg extension one at all…so you people are more strenuous in your research than gym people are. And they are probably more interested in people coming along and paying. (David)
Social Influences
It was three days a week I was compelled to get out of bed otherwise I was disappointing someone else by not showing up to an appointment. I was motivated to get out of bed. Whereas, prior to any of those activities, I was in bed at 11 o'clock in the morning. (Nate) I thought things have gone too far, done too much, been helped by too many people to sit here and go through all this bullshit again. (Nate) I just credit my life change to the assistance been given to me by you people. It's been great. (Nate) When they were little you wanted to see them, be there for them at that stage. And now, I want to be there for their teenage years. They're ten and twelve. Now I want to be there for X's eighteenth and hopefully contribute towards, if not buy her her first car. Then I want to do the same with Y I want to see X at university, she wants to be a veterinarian, and I want to be able to help her out there. Just as their life progresses in stages, be there for all of that. (Nate) I've been encouraged to do it [by] VU, staff, students, great people, yeah. And my wife. (Nate) I moved more, even away from stetching. I was a different person at home. I encouraged my wife to come out walking with me. She was happy to do that because it was good for me and also for her. Things just got better around the house and that. (Nate) When I came here, majority had issues with their weight as well. You felt like you had kinship with everybody and they all encouraged each other. There were a few people that we became quite friendly. We talked a little bit about our outside lives as well. We compared things and talked about stuff and we had ocmmon interests. So that side of it was really good. (Claire) There's also that side of it the social aspect. Meeting with people in similar situations and seeing their positive gains gives you a slightly more

positive view of, that things can be better. (Claire)
You know when you just link with the person doing the instructing? That worked really, really well. (Claire)
A couple of times I came in by myself and there were a lot of people. I was a bit self conscious.(Claire, barrier)
I can be honest and say that one thing I used to hate about the gym in the old days, before this, was that I always felt very self-conscious of the fact that I wasn't the perfect shape or the perfect size. Because a lot of the gyms, the majority of the people that go to the gym are ultra, super fit. They wear designer clothes, they sweat beautifully, their hair is up, and they're big and muscley. I would always sit there and try and move things. (Claire, barrier)
...except for that one annoying guy. He didn't stop me from coming. It just meant that sometimes you couldn't talk because his conversation would override everyone else's....so I just didn't join in on those days but I still came. (Claire, barrier)
Yeah it (was) beneficial (exercising with other study paricipants). Because you get to talk, share, compare and learn things about all these health things...share information which is really, really good. (Brenda)
You get motivated when you see other people losing weight. You think, if they can do it, I can do it. I think it's good to work with others I think, rather than on your own, it gets you more motivated. (Brenda)
But if I didn't have a friend to walk with I would get bored and not do it. So I wasn't doing any exercise. (Brenda, barrier)
Sometimes when you're with people they distract you. You can't really focus on what you're doing. I've got a friend that says, "come and do what I'm doing" or "I'll do what you're doing". Then I get lost and lose track. (Brenda, barrier)
I was doing better here (in the exercise study) than at the gym, actually. Because I think it was because of that personal training, somebody there to motivate and control everything. For example, now at the gym I feel like I've dropped the weights. I feel like I used to pull/push more weight. (Brenda, barrier)
I would do it here rather than outside. I prefer it here. I use the students for motivation. If I was at home I'd be less inclined to go to gym at 9am in the morning. I need to come here because I'm not going to reach those goals unless I do and I want to come here because I like the company and I like feeling as if somebody's keeping an eye on me. (Ruth)
It was just really nice, the 2 students I had were really great. They were always pleasant to talk to, I looked forward to going, I looked forward to the company, I actually felt as if people cared about me, so that was really nice. They did the stretching with me rather than just me doing it. So I really liked that. (Ruth)

Emotion
I moved more, even away from the stretching. I was a different person at home. I encouraged my wife to come out walking with me. She was happy to do that because it was good for me, and also for her. Things just got better around the house and that. (Nate) It was something that I really enjoy, I look forward to it. I don't even have to set an alarm clock to get out of bed to go and make my appointment at the gym and so forth. (Nate) It gave me purpose to get out of bed in the morning and something to look forward to. (Nate) (My mental health) was more low than up. But the up came with the progressing of the exercising with you guys. (Nate) It broke me up, yeah. I had mood swings and I went through denial again. I thought things have gone too far, done too much, been helped by too many people to sit here and go through all this bullshit again. So I got up, I didn't exercise as much as I had been, but I did exercise. Now I do cardio club...pretty extensive and exhaustive. (Nate, barrier) So I was seeing that exercise was keeping my numbers at an acceptable level. It helps with your mental health also because once you start seeing positive...because with my mental health it's more to do with my negative response to everything. I tend to have really negative responses and it was changing all the negative to positive. So it improved my mental health. (Claire) I wasn't feeling so revolting. I wasn't feeling so negative. It was making me more positive. I was feeling better. (Claire) Oh well I'm loving the gym. And I like how Watermark is so...there's so many different parts to it. I never thought I was gonna do aqua aerobics but I tried it. You know when you just link with the person who is doing the instructing. That worked really, really well. I started enjoying it and I felt the benefits of it. Especially with balance because I have such poor balance. I fall over so easily. I mean just enjoying...I go and I look forward to going. Even with the Wednesday morning ones. I teach Monday night and Tuesday night as well. So I work a full day and then teach in the night on Monday. Work a full day, teach in the night on Tuesday. Still get up at 5:30am on a Wednesday to go do my body balance class. So my body let's me wake up. I'll just let my body decide. If I don't wake up, I don't wake up. But every time it wakes me up. I just enjoy it. I like it and I'm glad it's there and I've got the option to go off and do it. (Claire) My just general, while feeling towards life was better. (Claire) It kept [blood sugar levels] constant, at a good level. I could say that there was definitely an affect because there was a period in there when I took some leave. I think I might have gone to Adelaide for a week or so or there was a 2 week break. And I noticed an effect on my sugar levels and my overall feeling of health. I was feeling quite lethargic not coming. I started to really miss coming to the gym. (Claire) I just realised that exercise is really so important. It's good for your diabetes, it's good for your wellbeing, it's good for your mental health. It just makes you feel good. You just feel like you've got a lot more energy afterwards. (Brenda) I just felt much more relaxed and happier after the sessions. (Brenda) I just noticed that basically you're just more motivated to get things done. Before you had to motivate yourself to do something; even to cook a meal, or clean the house, or run the kids around to different things. You had to sort of really push yourself. But if you've done the exercise

you'd have the energy to go the extra mile. It really does make you feel a lot better. (Brenda) (Prior to the exercise) I was feeling very lethargic. I was feeling really, extremely tired all the time. Sort of heavy headed and foggy in your thinking, like you're not sort of thinking clearly. I just felt I was never going forward, just sort of staying the same, not really improving. (Brenda, barrier) Yeah I guess (diabetes) just gives you like a feeling of low mood as well. You just don't feel motivated to get out there and do something. (Brenda, barrier) And it was just a bit of me time. Like, you know, when do you actually sit there and take the pressure off your neck by giving it a good stretch? I actually looked forward to that part of it. Even though it was an hour and a bit out of your day, it was actually not a bad hour and a bit out of your day. I used to have a massage once a month and I haven't been doing that anymore now. Money has been a bit tight. I'm working less. I don't think I need to as much because I don't hold the stress as much. The exercise helps me get rid of that. (Ruth) It was time for myself, and it felt good. You don't realise you're tight. You don't even realise you're holding it. It was a routine. You know, you don't realise how much stress you're holding until you start to release it and stretching really helped that. So it's really funny because it was the control group, but on the whole it was alright. (Ruth) I enjoy it. I enjoy the company and I enjoy the me time. (Ruth) I thought we were heading to have the sugar under control. With all of these (exercise programs) it's been coming down. That 3 month reading, it's been coming down. I got down to 7.8% I think it was, so I actually thought there was a good chance that this time I was gonna get down to the 7%. If I can get it to 7% I've got it under control, under reasonable control. And that's been my aim. And it was really heartbreaking to all of a sudden get 10% and then 11%. And it's because of the medication. So I'm going to discuss it with the gut clinic in a couple of weeks. But it mind mucks you. You think you're doing so well then it tells you you're doing so shitty. I mean like you've got no control over your body. No matter what you do. If you don't get that medication right, you're not gonna control it. (Ruth, barrier)
Behaviour regulation
I'm in bed at half past eight, asleep by nine I reckon...I'll sleep until I want to get out of bed. That's generally for the gym. Through the week the gym's open at six....I'm awake at four past six this morning, without the alarm. I go to the gym. Weekends, the gym's open at 7...I'm awake at four minutes past 6. (Nate) Getting the discipline back. It's the same as being in the gym. I have no trouble getting there but some days you feel oh I won't worry about doing that today. Then I think if I don't do it today then it's going to be harder to do tomorrow, so I'll do it today. I don't flog myself, but what I do is take my muscles to the limit without doing real heavy weights without exertion. Yeah, the discipline thing, attendance. It's the discipline thing, yeah. To do things, that's what I lost a few years ago. (Nate) Like, I don't have it [diabetes] anymore. I don't take medication for it, but I monitor it everyday. It's a positive influence. We're eating better, I am particularly. Life's 100%, 110% compared to when it was a minus 10 so it's come a long way. (Nate)

When I was told not to exercise at VU anymore, last year, in a period of four to six weeks I put on a few kilos. I said, “Bugger this, I’ll do me own thing.” So I started going to the gym again. (Nate)

I've just stuck with it. I've been encouraged to do it. It's just a matter of doing it, just accepting it as part of life. Ah look, I'm retired. I don't have to go to work. So, it takes me less than 10 inutes to get to the gym from my home. That 35 to 45 minutes in the gym. Then, say, 10 minutes to get home again. That's my days work. That's what I put it down to. I had eight hours to do it before, now I do it in an hour an a half. That's not hard to do. (Nate)

It (is) something that I really enjoy, I look forward to it. I don't even have to set an alarm clock to get out of bed to go and make my appointment at the gym and so forth. You know at VU it's not a burden to drive out from Bundoora to Footscray in peak traffic. It's just something I leave in time to do. I really enjoy it. (Nate)

When I was told to stop, that was it. I started to go backwards again. Four weeks...then it took me another two weeks just to get over being cheesed off and till I planned to do something…(Nate)

But now that I’m back at the gym, and because everything’s at an acceptable level...I also had to check my blood pressure as well. So getting that down, sleeping well, going to the gym, my sugar levels are down because I’m eating right. Because I’ve got more energy, I’m spending more time cooking good foods...When usually it would be like stagger out, throw the blood pressure pills in my mouth and stagger off to work. It has an impact on all of that sort of stuff. (Claire)

(feedback on progress is) very important because once I found that I was doing the right thing it’s really easy to continue doing that. (Claire)

Then when you have your annual reviews you find out that you're on track. You're keeping within the relevant levels - as long as you keep doing what you're doing now, keep doing it you'll be fine. (Claire)

I teach Monday night and Tuesday night as well. So I work a full day and then teach in the night on Monday. Work a full day, teach in the night on Tuesday. Still get up at 530am on a Wednesday to go do my body balance class. So my body let's me wake up. I'll just let my body decide. If I don't wake up, I don't wake up. But every time it wakes me up. I just enjoy it. I like it and I'm glad it's there and I've got the option to go off and do it. (Claire)

I go to a lot of the classes that are on there as well. So there's the body balance, Zumba…I go a couple of times a week and I look forward to it. Oh, the swimming, because they've got a pool, a hot pool! So I do aqua aerobics. Up until last week I was going Monday nights, Wednesday mornings, Thursday mornings and at some point during the week I would pop in for a gym session as well. (Claire)

Like the whole process was really good for physical health, it brought me up. Not perfectly because I’m still not at the optimum weight level. My levels, my diabetes still needs to be looked at. My blood pressure still needs to be monitored. My sleep apnoea is still there. Although it’s quite possible that it’s getting a bit better. My knees aren’t playing up at the moment. My hips aren’t playing up at the moment. (Claire)

I wrote down what I was doing here just before I left. I gave the gym instructors that program and we continued with that program. It’s actually exactly the same. I do the bike first. Then I do the chest press and then the leg press and then the low row. I was doing the pull down but I think I damaged my neck and shoulder a little bit. So he said to do the low row instead. And then I do some squats with the ball. Then I

do 100 calories on the treadmill. Then I do sit ups and that's it. So it's basically the same, it's similar. Basically I've kept the same program. They want me to change it, but I thought it was working. I keep getting a message on the computer saying your program is due for a review. But I don't go because I like what I'm doing and it works. I'm comfortable with what I'm doing so I haven't changed the program. (Brenda)
Perhaps the problem was that I was very over excited and I was going everyday. I think that's when I did the damage to my shoulder and then I lost a lot of weight. And I couldn't keep the momentum going. Perhaps I'll just go 3 times a week, Monday, Wednesday, Friday. Just do more aerobic, more cardiovascular exercise, and less weights. Perhaps introduce walking on the other days when I'm not at the gym. Actually there's a lot offering, they do water aerobics as well. They do a lot of classes in the water as well. In the hydrotherapy pool there's an arthritis class and there's a low impact class as well. Perhaps I could do some of those. (Brenda)
I do have a friend that could walk with me, actually. She doesn't live far from me I should actually organise a time. I don't mind the walk for socialising, it's fine. So maybe I could do that, introduce that a couple of times a week. It doesn't have to be high impact stuff. (Brenda)
Well I guess I've probably worked out that if I don't gym I should probably do some alternative exercise at home, but I don't. Like probably sit ups or wall squats. There's probably something I can do at home that I don't do. I don't have a treadmill either and I don't have a bike. I have a normal bike that I could ride. But probably the best thing would be to do some daily exercise. So just making sure that you include that in your daily routine. I don't know maybe I could do some exercise with the kids. I know (my daughter with Down Syndrome) has a tendency to over eat, so we're trying to cut down on her food. Maybe we should try and introduce some exercise as well for her. That would be good. Because I seem to have more time with her now, all my other kids are getting older and really growing independent. They don't need me as much. I could do more with her and it would benefit both of us. (Brenda)
Even when I've retired, and you'll still have me here, I'll be a client with those students. Because you can't get it, you couldn't pay for it. I've got two people who watch me and look after me if I've got a sore shoulder they'll give me an alternative. Like I've got a bit of bursitis in the shoulder, they'll always give me an alternative. I've got weak hips if I walk for long periods, so now they're giving me exercises to strengthen my hips. I've actually got people who care about how I feel and give me exercises to get past it. And I think the older I get the more aches and pains I'm probably going to have, so my intention is to keep on doing that. (Ruth)
If (volunteering for the student's is) not available, my husband is a veteran so he's got the Gold Card and he's in that veteran's program up at Keilor Downs. I could probably still go along and do water aerobics and stuff like that with them. So I will keep it going. (Ruth)
I understand my body so much better than what I did two or three years ago. I can even tell you what my heart rate would be right now. So I know how I feel, I know what my blood pressure would probably be around. I understand me, better. And that's just because of the regularity (of coming in for the exercise sessions). And I know that if I feel tired I won't feel tired for long once I start (the exercise). (Ruth)
But walking has been changed lately because of my knees have been swelling up a lot. So I don't do as much walking as I used to. But it's alright, because I've been doing it here at uni…so it's okay.(Ruth)
I still walk quickly to here and there sort of thing and I think that's part of the (glucose) control. I record my blood sugars on spreadsheets. Daily averages on the vertical and monthly averages on the horizontal…so I can see what's going on. I suspect that if I do get high (blood

gluose readings), I'll just walk around the block and that'll get rid of it. (David) (Q: Have you continued exercising?) Not as such. However, little things like going to Safeway…with the car parked to the building itself…is an upward ramp and I deliberately walk up that as fast as I can to see if I'm cramped up at the top. But I don't even notice until I leave the shop and I think, "oh nothing happened did it?" (David)

Appendix F: CALO-RE Taxonomy and BCI-EP

Table F1. Items in the CALO-RE Taxonomy and BCI-EP

Item	CALO-RE	BCI-EP
1	Provide information on consequences of behaviour in general	Provide **general** information on the benefits of exercise for all people. For example, tell the client about the general health benefits of exercise.
2	Provide information on consequences of behaviour to the individual	Provide information on the **personal** benefits of exercise for the client. For example, if the client has an injury, provide information about how exercise can help with rehabilitation for that specific injury.
3	Provide information about others' approval	Discuss what other people will like, approve or disapprove about the client's exercise participation. For example, discuss why the client's General Practitioner might approve of the client engaging in exercise.
4	Provide normative information about others' behaviour	Provide information about the types of exercise that other people, similar to the client, are doing. For example, informing the client that exercise is common amongst people who are of similar age to the client or with the same health condition/injury/illness.
5	Goal setting (behaviour)	Encourage the client to set goals about their **participation** in exercise. For example, a goal might be to exercise 3 times per week.
6	Goal setting (outcome)	Encourage the client to set goals about the **outcomes** of participation in exercise. For example, goals to increase their strength or to reduce their blood pressure.
7	Action planning	Encourage the client to develop an action plan. This is a detailed plan for participation in exercise, including when (i.e., day or the week, time of day), in which situation and/or where to perform exercise sessions (i.e.,, at home, in the park, at the gym).
8	Barrier identification/problem solving	Encourage the client to identify potential barriers to exercise and how they might overcome these barriers. For example, client identifies lack of time as a barrier and overcomes this by getting up an hour earlier to fit in exercise before work.

Item	CALO-RE	BCI-EP
9	Set graded tasks	Break down the exercise program into smaller, easier to achieve tasks and enable the client to build on small successes to achieve target exercise levels. For example, 5-10 minutes of exercise at a time until the client can complete 30 minutes of continuous exercise.
10	Prompt review of behavioural goals	Review the extent to which previously set exercise **participation** goals were achieved. For example, if the client's goal was to exercise 3 times per week, review this goal in two months to see if the client achieved it.
11	Prompt review of outcome goals	Review the extent to which previously set **outcome** goals were achieved. For example, if the client's goal was to increase their strength, review in one month to see if the goal was achieved.
12	Prompt rewards contingent on effort or progress towards behaviour	Praise or reward clients for **attempts** at achieving an exercise goal. For example, praise client for attempting to meet their exercise goal, even if they do not meet it.
13	Provide rewards contingent on successful behaviour	Provide praise or rewards **only** if the client reaches their exercise goal. For example, the client received praise or reward for meeting their exercise goal.
14	Shaping	Initially provide praise or rewards for any attempt to exercise. Then, later, provide praise or reward for only more demanding exercise.
15	Prompting generalisation of a target behaviour	Once exercise is regularly performed in a particular situation, encourage the client to try exercising in another situation. For example, from running on a treadmill to running outside.
16	Prompt self-monitoring of behaviour	Ask the client to keep a record of exercise behaviours for self-monitoring. For example, keeping an exercise diary.
17	Prompt self-monitoring of behavioural outcome	Ask the client to keep a record of outcomes expected to be influenced by exercise. For example, keeping a record of blood pressure, blood glucose, weight loss.
18	Prompting focus on past success	Instruct the client to think about or list previous successes in performing exercise. For example, when they did not feel like exercising but were able to do it anyway.

Item	CALO-RE	BCI-EP
19	Provide feedback on performance	Provide client with information about their own exercise behaviour or comment on their exercise performance. For example, number of sessions performed or attended each month
20	Provide information on where and when to perform the behaviour	Provide information (written or verbal) on where and when to perform exercise (e.g., times of local exercise classes, nearby walking tracks).
21	Provide instruction on how to perform the behaviour	***Tell*** the client (written or verbal) how to perform the exercises. For example, instructions on how to use gym equipment without providing a demonstration)
22	Model/Demonstrate the behaviour	***Show*** the client how to perform the exercises. For example, physical or visual demonstrations of the exercise
23	Teach to use prompts/cues	Teach the client to identify environmental cues that can be used to remind them to exercise. For example, mobile phone alerts to prompt them to perform the exercise.
24	Environmental restructuring	Encourage the client to change their environment in ways that is more supportive of exercising. For example, taking their running shoes to work).
25	Agree behavioural contract	Develop a written agreement, 'behavioural contract', that the client signs and agrees to perform the exercise program.
26	Prompt practice	Encourage the client to rehearse or prepare for the exercise, numerous times. For example, have the client rehearse a heavy set in their mind in preparation for completing the exercise.
27	Use of follow-up prompts	Gradually reduce the frequency of contacts with the client to promote self-management of exercise.
28	Facilitate social comparison	Prompt comparisons with other people in similar situations. For example, people of a similar age or people with the same health condition/injury/illness
29	Plan social support/social change	Encourage the client to develop social support from other people to help them to achieve their exercise goals. For example, setting up an exercise 'buddy' system.

Item	CALO-RE	BCI-EP
30	Prompt identification as role model/position advocate	Focus on how the client could be an example to others and influence their behavior. For example, being a good example to children or providing opportunities for clients to persuade others of the importance of exercise through giving a talk or running a peer-led session.
31	Prompt anticipated regret	Prompt expectations of future regret about the performance or nonperformance of exercise. For example, focusing on how the client may feel if they do not exercise.
32	Fear arousal	Discuss the risk and/or mortality information of not engaging in exercise to evoke a fearful response of not exercising.
33	Prompt self-talk	Encourage the client to talk to themselves (aloud or silently) before and during exercise sessions to encourage, support and maintain participation.
34	Prompt use of imagery	Teach the client to imagine successfully performing exercise or to imagine finding it easy to perform exercise.
35	Relapse prevention/coping planning	Prompt the client to identify, in advance, situations in which exercise may not be maintained and develop strategies to avoid or manage those situations. For example, when the client's work schedule increases.
36	Stress management/emotional control training	Use specific techniques (e.g., progressive relaxation) that seek to reduce anxiety and stress to facilitate exercise participation. These techniques are not directed towards performance of exercise, but rather seek to reduce barriers and facilitate exercise.
37	Motivational interviewing	Motivational interviewing or counselling to prompt the client to engage in 'change talk' in order to minimise resistance and resolve ambivalence to exercising.
38	Time management	Teach the client how to manage their time in order to allow for exercise.
39	General communication skills training	Teach the client general communication skills to reduce barriers to exercise.
40	Stimulate anticipation of future rewards	During an exercise session, focus on the reward at the end of the exercise, rather than the exercise itself.

Note. Adapted from "A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: The CALO-RE taxonomy," by S. Michie, S. Ashford, F. Sniehotta, S. Dombrowski, A. Bishop, D. French, 2011, *Psychology and Health, 26*(11), p. 1479.

Appendix G: Participant Information and Consent Form (Pilot Study)

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH

You are invited to participate

You are invited to participate in a research project entitled 'Behavioural Strategies used by Exercise Practitioners: Pilot Study'.

This project is being conducted by Dr Melinda Craike, Dr Zali Yager, and Dr Siân McLean from Victoria University; Professor Stuart Biddle and Dr Jason Bennie from the University of Southern Queensland

Your participation in this study is completely voluntary and you can withdraw at any time.

Project explanation

We are developing a survey to examine the behavioural strategies that are used by Exercise Professionals when working with clients. We are conducting a pilot study of the survey prior to the main study to find out how easy the questions are to understand. We are interested in your views as someone who works in an exercise or fitness related role.

What will I be asked to do?

If you decide to participate, you will be asked to complete a survey and then participate in an interview (over the phone). During the interview, we will ask you some questions about the content of the survey and your experience in completing the survey; including the identification of questions that you believe were not clear or difficult to answer.

Your responses are confidential and the survey and interview will take a total of approximately 20-30 minutes to complete. We will call you to determine your interest in participating in the study and answer any questions that you may have. We will also arrange a time for the interview.

What will I gain from participating?

You may benefit from participating in the study by gaining experience in survey item development and reflecting on your own practice.

How will the information I give be used?

Pooled results of this pilot study will be used to amend the survey and may be used in a research publication.

What are the potential risks of participating in this project?

Any discomfort or inconvenience to you derives only from the amount of time taken to complete the survey and associated questions.

How will this project be conducted?

Information will be gathered from exercise practitioners who work in a range of settings.

Who is conducting the study?

Dr Melinda Craike
Institute of Sport, Exercise and Active Living
Phone 99195659, email: Melinda.craike@vu.edu.au.

Any queries about your participation in this project may be directed to the Chief Investigator listed above.

If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001, email researchethics@vu.edu.au or phone (03) 9919 4781 or 4461.

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CONSENT FORM FOR PARTICIPANTS INVOLVED IN RESEARCH

CERTIFICATION BY PARTICIPANT

I, "[Click here & type participant's name]"
of "[Click here & type participant's suburb]"

certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in the study: 'Behavioural Strategies used by Exercise Practitioners to Improve Uptake and Adherence to Exercise: Pilot Study'. This project is being conducted by Dr Melinda Craike, Dr Zali Yager, and Dr Siân McLean from Victoria University; Professor Stuart Biddle and Dr Jason Bennie from the University of Southern Queensland

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the research, have been fully explained to me by a member of the research team and that I freely consent to participation involving the below mentioned procedures:

- Completion of a survey
- Participation in an interview to answer question about my experiences in completing the survey

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

Signed:

Date:

Any queries about your participation in this project may be directed to the chief investigator:
Dr Melinda Craike
Institute of Sport, Exercise and Active Living
Phone 99195659, email: Melinda.craike@vu.edu.au

If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001, email Researchethics@vu.edu.au or phone (03) 9919 4781 or 4461.

Appendix H: Questionnaire (Pilot Study)

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Behavioural Strategies among Exercise Physiologists in Australia

Questionnaire

Instructions

This survey includes questions about the behavioural strategies that are used by AEPs when working with clients. We are asking you to complete this survey because you have been identified as an AEP. We are interested in your experiences and perceptions as an AEP. We are interested in your opinion about the acceptability, length, and clarity of the survey questions. We would therefore welcome if you can provide us any feedback you might have about any question in this survey. Please feel free to provide this feedback either in track changes (if using Microsoft Word version) or mark them down with a pen if you're using the hard copy.

Part A: About You

1. Are you registered with ESSA?

- ☐ Yes
- ☐ No

2. What is your gender?

- ☐ Male
- ☐ Female
- ☐ Unspecified

3. Please select your age

- ☐ 18 - 24
- ☐ 25 - 34
- ☐ 35 - 44
- ☐ 45 - 54
- ☐ 55 - 64
- ☐ 65+

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4. How long have you been employed as an AEP?

- ☐ Less than 1yr
- ☐ 1-3yrs
- ☐ 4-7yrs
- ☐ 7-10yrs
- ☐ 10yrs +

5. What best describes your current employment situation as an AEP?

- ☐ Full time (one role)
- ☐ Full time (multiple roles)
- ☐ Part time
- ☐ Casual
- ☐ Unpaid/Volunteer
- ☐ Other

Part B: Behavioural Strategies

6. We are interested in how often you use behavioural strategies when working with clients. There are no right or wrong answers; we are interested in what you currently do. The strategies could be delivered in person, electronically (e.g., text message, email), in written form (e.g., information sheet) or over the phone. Please read the whole statement carefully before responding, some of the statements are similar. Please select one response for each item.

	Never	Rarely	Sometimes	Always
1. Provide general information on the costs or benefits of exercise	☐	☐	☐	☐
2. Provide personalised information on the costs or benefits of exercise for the client	☐	☐	☐	☐
3. Discuss what other people will like, approve or disapprove about the client's exercise participation	☐	☐	☐	☐
4. Provide information about the types of exercise that other similar people are doing	☐	☐	☐	☐

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5. Encourage goal setting for **participation** in exercise (e.g., participate in more exercise next week).	☐	☐	☐	☐
6. Encourage goal setting for **outcomes** of participation in exercise (e.g. to reduce blood pressure or lose/maintain weight)	☐	☐	☐	☐
7. Encourage detailed planning of participation in exercise, including when, in which situation and/or where to perform exercise sessions	☐	☐	☐	☐
8. Engage with the client in barrier identification/problem solving	☐	☐	☐	☐
9. Break down the exercise program into smaller, easier to achieve tasks and enable the client to build on small successes to achieve target exercise levels	☐	☐	☐	☐
10. Review the extent to which previously set exercise behavioural goals were achieved.	☐	☐	☐	☐
11. Review the extent to which previously set outcome goals were achieved.	☐	☐	☐	☐
12. Praise or reward clients for attempts at achieving an exercise goal	☐	☐	☐	☐
13. Provide rewards contingent on reaching the exercise goal	☐	☐	☐	☐
14. Shaping. Initially providing contingent rewards for any approximation to the target behaviour e.g. for any increase in exercise. Then, later, only a more demanding performance, e.g. brisk walking for 10min on 3 days a week, would be rewarded.	☐	☐	☐	☐

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15. Once exercise is regularly performed in a particular situation, encourage the client to try exercising in another situation	☐	☐	☐	☐
16. Ask the client to keep a record of specific exercise behaviours for self-monitoring	☐	☐	☐	☐
17. Ask the client to keep a record of specific outcomes expected to be influenced by exercise	☐	☐	☐	☐
18. Instruct the client to think about or list previous successes in performing exercise	☐	☐	☐	☐
19. Provide client with data about their own exercise behaviour or comment on their exercise performance	☐	☐	☐	☐
20. Provide information (written or verbal) on where and when to perform exercise	☐	☐	☐	☐
21. ***Tell*** the client (written or verbal) how to perform the exercises	☐	☐	☐	☐
22. ***Show*** the client how to perform the exercises	☐	☐	☐	☐
23. Teach the client to identify environmental prompts or cues which can be used to remind them to exercise	☐	☐	☐	☐
24. Prompt the client to alter their environment in ways that is more supportive of exercising (e.g., taking their running shoes to work).	☐	☐	☐	☐
25. Develop a written agreement, 'behavioural contract', that the client perform the exercise program.	☐	☐	☐	☐
26. Encourage the client to rehearse and repeat the exercise or preparations for exercise, numerous times	☐	☐	☐	☐

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27. Gradually reduce the intensity, duration or frequency of contacts with the client to promote self-management of exercise	☐	☐	☐	☐
28. Draw attention to others' exercise and elicit comparisons with similar others (social comparison)	☐	☐	☐	☐
29. Encourage the client to develop strategies on how to encourage social support from other people to achieve his/her exercise goals.	☐	☐	☐	☐
30. Focus on how the client could be an example to others and influence others behaviour	☐	☐	☐	☐
31. Prompt expectations of future regret about the performance or non-performance of exercise	☐	☐	☐	☐
32. Discuss the risk and/or mortality information of not engaging in exercise to evoke a fearful response	☐	☐	☐	☐
33. Encourage the client to talk to themselves (aloud or silently) before and during exercise sessions to encourage, support and maintain participation.	☐	☐	☐	☐
34. Teach the client to imagine successfully performing the behaviour or to imagine finding it easy to perform the behaviour.	☐	☐	☐	☐
35. Prompt the client to identify in advance situations in which exercise may not be maintained and develop strategies to avoid or manage those situations	☐	☐	☐	☐
36. Use specific techniques (e.g. progressive relaxation) which do not target the exercise directly, but seek to reduce anxiety and stress to facilitate the exercise participation.	☐	☐	☐	☐
37. Motivational interviewing/counselling to prompt the client to engage in change talk in order to minimise resistance and resolve ambivalence to change.	☐	☐	☐	☐

38. Teach the client how to manage their time in order to make time for exercise.	☐	☐	☐	☐
39. Teach the client general communication skills, including any technique directed at general communication skills but not directed towards exercise.	☐	☐	☐	☐
40. Create anticipation of future rewards without necessarily reinforcing exercise throughout the exercise sessions.	☐	☐	☐	☐

7. If you have indicated in the previous questions that you employ some of the behavioural change strategies, how do you usually deliver these messages to your clients?

- ☐ In person
- ☐ Electronically (e.g., text message, email)
- ☐ Over the phone
- ☐ In written form (e.g., letter, information sheet)
- ☐ Other (Please specify) _____

8. Please rate your level of agreement with the following statements:

	Strongly disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
Adherence to exercise is high among my clients	☐	☐	☐	☐	☐
My clients adhere to the exercises I prescribe to them	☐	☐	☐	☐	☐

9. Please provide any additional feedback you might have with regards to the clarity of this survey:

Thank you for taking your time. Please ensure you return this survey to the email or postal address as specified below:

Dr Melinda Craike
Victoria University
PO Box 14428
Melbourne, Victoria 8001
Institute of Sport, Exercise and Active Living
Phone 99195659, email: Melinda.craike@vu.edu.au.

Appendix I: Interview Schedule (Pilot Study)

Pilot Study Interview Schedule

Thank you for participating in this study. Have you completed the survey?

If no- let participant know that you will call back once they have completed the survey. Arrange alternative time

If yes- continue

Were the instructions easy or hard to follow?

Do you have any suggestions for improving the instructions?

Are the survey items relevant to your practice?

Were any items difficult to answer? Identify each answer and explain.

Were there any items that you did not understand and required further clarification?

Do you have any suggestions for improving the clarity of the items?

In your own words, what were the items assessing?

Appendix J: Online Questionnaire

Behavioural Strategies among Exercise Practitioners in Australia
Questionnaire

Part A: About You

What is your gender?

- Female
- Male
- Other

Please select your age:

- 18 – 24 years
- 25 – 34 years
- 35 – 44 years
- 45 – 54 years
- 55 – 64 years
- 65+ years

How long have you been employed as an exercise practitioner?

- Less than 1 year
- 1-3 years
- 4-7 years
- 7-10 years
- 10 + years

What is your role (select as many options as appropriate):

- Group exercise instructor
- Gym instructor
- Personal trainer
- Accredited exercise physiologist (AEP)
- Other (please specify)

Which of the following best describes your employment status?

- ☐ Full time (one role)
- ☐ Full time (multiple roles)
- ☐ Part time
- ☐ Casual
- ☐ Unpaid/Volunteer
- ☐ Other

What is your highest exercise related qualification?

- ☐ Certificate III in Fitness
- ☐ Certificate IV in Fitness
- ☐ Diploma of Fitness
- ☐ Undergraduate degree in Exercise Sciences or similar
- ☐ Post graduate qualification in Exercise Sciences or similar

What is the postcode of the place you usually live in?

What is the postcode of your main place of employment?

What best describes the setting you most commonly work in?

- ☐ Hospital
- ☐ Large corporate gym or fitness centre (>500 members)
- ☐ Medium size gym or fitness centre (between 100-500 members)
- ☐ Small studio setting
- ☐ Outdoor setting
- ☐ Train clients from own home/visit client's home
- ☐ Other- please describe

Which of the following client groups do you work with most of the time?

- ☐ General population
- ☐ People with cancer
- ☐ People with cardiovascular conditions
- ☐ People with kidney conditions
- ☐ People with mental illness
- ☐ People with metabolic conditions
- ☐ People with musculoskeletal conditions
- ☐ People with neurological conditions
- ☐ People with respiratory/Pulmonary conditions
- ☐ Other- please specify

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Part B: Behavioural Strategies

This survey includes questions about the behavioural strategies that are used by exercise practitioners when working with clients to help clients to increase and/or maintain their level of participation in exercise. Examples of strategies include: goal setting, praise or rewards. Behavioural strategies include the things that you do to help to increase your client's motivation so that they can improve and/ and maintain their participation in exercise.

The questions refer to behavioural strategies that are used either during the initial consultation with a client or during ongoing consultations.

The strategies could be delivered in person, electronically (e.g., text message, email), in written form (e.g., information sheet) or over the phone

There are no right or wrong answers; we are interested in what you currently do. Please read the whole statement carefully before responding because some of the statements are similar. Please select one response for each item.

If you feel that an item is not applicable for you, then please select 'never'.

How often do you:

	Never	Rarely	Sometimes	Most of the time
1. Provide **general** information on the benefits of exercise for all people. For example tell the client about the general health benefits of exercise.	□	□	□	□
2. Provide information on the **personal** benefits of exercise for the client. For example, if the client has an injury, provide information about how exercise can help with rehabilitation for that specific injury.	□	□	□	□
3. Discuss what other people will like, approve or disapprove about the client's exercise participation. For example, discuss why the client's General Practitioner might approve of the client engaging in exercise.	□	□	□	□
4. Provide information about the types of exercise that other people, similar to the client, are doing. For example, informing the client that exercise is common amongst people who are of similar age to the client or with the same health condition/injury/illness.	□	□	□	□
5. Encourage the client to set goals about their **participation** in exercise. For example, a goal might be to exercise 3 times per week.	□	□	□	□

6. Encourage the client to set goals about the **outcomes** of participation in exercise. For example, goals to increase their strength or to reduce their blood pressure.	□	□	□	□
7. Encourage the client to develop an action plan. This is a detailed plan for participation in exercise, including when (i.e. day or the week, time of day), in which situation and/or where to perform exercise sessions (i.e. at home, in the park, at the gym).	□	□	□	□
8. Encourage the client to identify potential barriers to exercise and how they might overcome these barriers. For example, client identifies lack of time as a barrier and overcomes this by getting up an hour earlier to fit in exercise before work.	□	□	□	□
9. Break down the exercise program into smaller, easier to achieve tasks and enable the client to build on small successes to achieve target exercise levels. For example, 5-10 minutes of exercise at a time until the client can complete 30 minutes of continuous exercise.	□	□	□	□
10. Review the extent to which previously set exercise **participation** goals were achieved. For example, if the client's goal was to exercise 3 times per week, review this goal in two months to see if the client achieved it.	□	□	□	□
11. Review the extent to which previously set **outcome** goals were achieved. For example if the client's goal was to increase their strength, review in one month to see if the goal was achieved.	□	□	□	□
12. Praise or reward clients for **attempts** at achieving an exercise goal. For example, praise client for attempting to meet their exercise goal, even if they do not meet it.	□	□	□	□
13. Provide praise or rewards **only** if the client reaches their exercise goal. For example, the client received praise or reward for meeting their exercise goal.	□	□	□	□
14. Initially provide praise or rewards for any attempt to exercise. Then, later, provide praise or reward for only more demanding exercise.	□	□	□	□

15. Once exercise is regularly performed in a particular situation, encourage the client to try exercising in another situation. For example, from running on a treadmill to running outside.	□	□	□	□
16. Ask the client to keep a record of exercise behaviours for self-monitoring. For example, keeping an exercise diary.	□	□	□	□
17. Ask the client to keep a record of outcomes expected to be influenced by exercise. For example, keeping a record of blood pressure, blood glucose, weight loss.	□	□	□	□
18. Instruct the client to think about or list previous successes in performing exercise. For example when they did not feel like exercising but were able to do it anyway.	□	□	□	□
19. Provide client with information about their own exercise behaviour or comment on their exercise performance. For example, number of sessions performed or attended each month	□	□	□	□
20. Provide information (written or verbal) on where and when to perform exercise (e.g., times of local exercise classes, nearby walking tracks).	□	□	□	□
21. ***Tell*** the client (written or verbal) how to perform the exercises. For example, instructions on how to use gym equipment without providing a demonstration)	□	□	□	□
22. ***Show*** the client how to perform the exercises. For example, physical or visual demonstrations of the exercise	□	□	□	□
23. Teach the client to identify environmental cues that can be used to remind them to exercise. For example, mobile phone alerts to prompt them to perform the exercise.	□	□	□	□
24. Encourage the client to change their environment in ways that is more supportive of exercising. For example, taking their running shoes to work).	□	□	□	□
25. Develop a written agreement, 'behavioural contract', that the client signs and agrees to perform the exercise program.	□	□	□	□

26. Encourage the client to rehearse or prepare for the exercise, numerous times. For example, have the client rehearse a heavy set in their mind in preparation for completing the exercise.	□	□	□	□
27. Gradually reduce the frequency of contacts with the client to promote self-management of exercise.	□	□	□	□
28. Prompt comparisons with other people in similar situations. For example, people of a similar age or people with the same health condition/injury/illness	□	□	□	□
29. Encourage the client to develop social support from other people to help them to achieve their exercise goals. For example, setting up an exercise 'buddy' system.	□	□	□	□
30. Focus on how the client could be an example to others and influence their behavior. For example, being a good example to children or providing opportunities for clients to persuade others of the importance of exercise through giving a talk or running a peer-led session.	□	□	□	□
31. Prompt expectations of future regret about the performance or non-performance of exercise. For example, focusing on how the client may feel if they do not exercise.	□	□	□	□
32. Discuss the risk and/or mortality information of not engaging in exercise to evoke a fearful response of not exercising.	□	□	□	□
33. Encourage the client to talk to themselves (aloud or silently) before and during exercise sessions to encourage, support and maintain participation.	□	□	□	□
34. Teach the client to imagine successfully performing exercise or to imagine finding it easy to perform exercise.	□	□	□	□
35. Prompt the client to identify, in advance, situations in which exercise may not be maintained and develop strategies to avoid or manage those situations. For example, when the client's work schedule increases.	□	□	□	□

36. Use specific techniques (e.g. progressive relaxation) that seek to reduce anxiety and stress to facilitate exercise participation. These techniques are not directed towards performance of exercise, but rather seek to reduce barriers and facilitate exercise.	□	□	□	□
37. Motivational interviewing or counselling to prompt the client to engage in 'change talk' in order to minimise resistance and resolve ambivalence to exercising.	□	□	□	□
38. Teach the client how to manage their time in order to allow for exercise.	□	□	□	□
39. Teach the client general communication skills to reduce barriers to exercise.	□	□	□	□
40. During an exercise session, focus on the reward at the end of the exercise, rather than the exercise itself.	□	□	□	□

If you have indicated in the previous questions that you employ some of the behavioural change strategies, how do you usually deliver these messages to your clients? *Tick all that apply*

- ☐ In person
- ☐ Electronically (e.g., text message, email)
- ☐ Over the phone
- ☐ In written form (e.g., letter, information sheet)
- ☐ Other (Please specify)

Please rate your level of agreement with the following statements:

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Adherence to exercise is high among my clients	☐	☐	☐	☐	☐
My clients adhere to the exercises I prescribe to them	☐	☐	☐	☐	☐

Training

The next questions are about your training as an exercise practitioner.

Please indicate the quantity of training you received regarding the following:

Identifying clients struggling with body image concerns

None at all _____ A great deal

Impact on clients of experiences of weight stigma (bias or negative attitudes against people who are overweight or obese)

None at all _____ A great deal

Effective communication skills when working with people with body image concerns or who have experiences of weight stigma

Not at all _____ Very much so

Reasons for drop out

How important are the following factors in contributing to client drop-out?

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
Lack of time	☐1	☐2	☐3	☐4	☐5
Feeling intimidated or uncomfortable in exercise setting	☐1	☐2	☐3	☐4	☐5
Feeling unable to meet performance expectations	☐1	☐2	☐3	☐4	☐5
Feeling unable to meet appearance expectations	☐1	☐2	☐3	☐4	☐5
Too expensive	☐1	☐2	☐3	☐4	☐5
Inconvenient	☐1	☐2	☐3	☐4	☐5
Feeling self-conscious about their body size	☐1	☐2	☐3	☐4	☐5

Body acceptance

The following questions are about body acceptance which refers to being comfortable with and accepting and respecting one's body (even if it does not look like one might wish)

What are your thoughts about body acceptance (please tick all that apply)

Body acceptance helps clients to focus on fitness outcomes

Not at all _____ Very True

Body acceptance gets in the way of clients' achieving weight loss goals

Not at all _____ Very True

Clients who embrace body acceptance are less likely to look after their health and fitness

Not at all _____ Very True

Body acceptance promotes good mental health

☐

Not at all _____ Very True

How important is it to your clients that their exercise setting makes them feel comfortable about the way that they look?

Not at all important _____ Extremely important

How important is it to your clients that their exercise practitioner supports them to develop body acceptance?

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Not at all important — Extremely important

How important is it to your professional practice that you promote body acceptance?

Not at all important — Extremely important

How confident are you in promoting body acceptance in your clients?

Not at all confident — Extremely confident

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Weight stigma

The following questions are about stigmatizing or negative attitudes towards people of larger body sizes

To what extent might the environment of your exercise setting (inadvertently) make people of larger body sizes feel uncomfortable ?

Not at all _____ A great deal

How confident are you in identifying instances of weight stigma occurring in your exercise setting?

Not at all confident _____ Extremely confident

How confident are you to assist clients to stop making negative comments about, or stigmatising themselves for having a larger body size?

Not at all confident _____ Extremely confident

How confident are you that your behaviours in the exercise setting do not stigmatise people of larger body sizes?

Not at all confident _____ Extremely confident

To what extent do you think that exercise environments that make larger people feel uncomfortable might make them drop out of exercise

Not at all aware _____ Fully aware

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Prize Draw

Do you wish to go in to the draw to win a $100 Rebel Sport Voucher?
If so, please include your name and telephone number below

Interest in further research

In the future, we may be conducting further research on the experiences and practices of exercise practitioners. If you might be interested in participating in this research, please provide our name, email address and phone number and a member of our research team may contact you in the future. By providing your details you are under no obligation to participate in further research.

I do not consent to being contacted about future research

I consent to being contacted about future research

Name

Email

Phone

Thank you for your time in completing this survey. Your response is very important

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Appendix K: Information to Participants and Consent Form

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH

You are invited to participate

You are invited to participate in a research project entitled 'Behavioural Strategies used by Exercise Practitioners'.

This project is being conducted by Dr Melinda Craike, Dr Zali Yager, and Dr Siân McLean from Victoria University; Professor Stuart Biddle and Dr Jason Bennie from the University of Southern Queensland; and A/Prof Prue Cormie from Australian Catholic University.

Your participation in this study is completely voluntary and you can withdraw at any time.

Project explanation

We are inviting exercise practitioners to complete an online survey about their experiences, beliefs and practices as an exercise practitioner. The online survey includes questions about the behavioural strategies that are used by exercise practitioners when working with clients to help improve their uptake and adherence to exercise and also experience and beliefs relating to body acceptance among clients. We are asking you to complete this survey because you have been identified as an exercise practitioner and we are interested in your experiences and views.

What will I be asked to do?

Your will be asked to complete an online survey that will take 15-20 minutes to complete. Your responses are completely anonymous.

You will be asked questions about:

- Information about you (your age, education, number of years as an exercise practitioner etc.)
- The behavioural strategies do you currently use with clients, for example, goal setting, giving praise and rewards
- Your perceptions and experiences relating to body acceptance among clients

Your completion of the survey is implied consent.

What will I gain from participating?

Potential benefits to study participants include an opportunity to reflect on your practice. Potential benefits for the body of knowledge include identification of behavioural strategies that exercise practitioners use to promote uptake and adherence to exercise. The study findings will assist in the development of professional skill development of exercise practitioners and will assist in the design of interventions to aid client uptake and adherence to exercise programs.

How will the information I give be used?

Pooled results of this study will be used in scientific and public health related publications, research reports and conference presentations.

What are the potential risks of participating in this project?

Risks to study participants are minimal. Any discomfort or inconvenience to you derives only from the amount of time taken to complete the online survey.

How will this project be conducted?

Information will be gathered by inviting exercise practitioners who work in a range of settings to complete the online survey.

Who is conducting the study?

Dr Melinda Craike
Institute of Sport, Exercise and Active Living
Phone 99195659, email: Melinda.craike@vu.edu.au.

Any queries about your participation in this project may be directed to the Chief Investigator listed above.

If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001, email researchethics@vu.edu.au or phone (03) 9919 4781 or 4461.

Consent:

I (the participant) have read and understood the participant information sheet. I agree to participate in the survey, realising that I have the option not to answer any questions or submit the survey at any time. I agree that information provided by me or with my permission may be included presented at conferences, include in a thesis, published in journals or for media releases on the condition that neither my name nor any other identifying information is used.

If you agree to participate in this survey please click "I agree to participate in this study" below and you will be directed to the survey;

If you do not wish to participate in this survey please click, "I do not wish to be involved in this study"'

I agree to participate in this study
I do not wish to be involved in this study

Appendix L: Nonparametric Statistics

Table L1. Mann Whitney Test for Exercise Practitioner Gender

	Mean Rank		Z
	Female (*n* = 39)	Male (*n* = 15)	
Social influences	28.41	25.13	-.689
Goals	27.91	26.43	-.324
Reinforcement	27.47	27.57	-.019
Behaviour regulation	29.24	22.97	-1.387
Environmental context and resources	30.03	20.93	-1.960*
Beliefs about consequences	27.68	27.03	-.141

*p = .05

Table L2. Mann Whitney Test for Exercise Practitioner Age

	Mean Rank		Z
	≤ 34 years (*n* = 36)	≥ 35 years (*n* = 18)	
Social influences	25.15	32.25	-1.577
Goals	26.71	29.08	-.548
Reinforcement	24.14	34.22	-2.237*
Behaviour regulation	23.07	36.36	-3.090*
Environmental context and resources	27.25	28.00	.170
Beliefs about consequences	24.00	34.50	-2.407*

*p <.05

Table L3. Mann Whitney Test for Exercise Practitioner Employment Years

	Mean Rank		Z
	≤ 7 years (*n* = 29)	≥ 8 years (*n* = 25)	
Social influences	25.86	29.40	-.829
Goals	27.38	27.64	-.064
Reinforcement	24.43	31.06	-1.555
Behaviour regulation	25.55	29.76	-1.035
Environmental context and resources	25.52	29.80	-1.028
Beliefs about consequences	25.57	29.74	-1.011

Table L4. Mann Whitney Test for Exercise Practitioner Role

	Mean Rank		Z
	Other (*n* = 10)	AEP (*n* = 44)	
Social influences	33.30	26.18	-1.299
Goals	23.75	28.35	-.876
Reinforcement	42.60	24.07	-3.387*
Behaviour regulation	33.70	26.09	-1.458
Environmental context and resources	26.90	27.64	-.138
Beliefs about consequences	33.25	26.19	-1.333

*p = .001

Table L5. Mann Whitney Test for Exercise Practitioner Education

	Mean Rank		Z
	No post (*n* = 19)	Postgrad (*n* = 35)	
Social influences	27.82	27.33	-.109
Goals	28.50	26.96	-.361
Reinforcement	29.34	26.50	-.639
Behaviour regulation	30.05	26.11	-.928
Environmental context and resources	26.84	27.86	-.233
Beliefs about consequences	29.29	26.53	-.641

Note. No post = No postgraduate qualification.

Table L6. Mann Whitney Test for Socioeconomic Advantage

	Mean Rank		Z
	Disad (*n* = 25)	Ad (*n* = 29)	
Social influences	26.64	28.24	-.375
Goals	27.50	27.50	-000
Reinforcement	25.06	29.60	-1.066
Behaviour regulation	29.60	25.69	-.962
Environmental context and resources	25.68	29.07	-.813
Beliefs about consequences	25.10	29.57	-1.084

Note. Socioeconomic advantage refers to postcode of exercise practitioner employment location based on the Index of Relative Socioeconomic Advantage and Disadvantage (ABS, 2018). Disad = socioeconomically disadvantaged. Ad = socioeconomically advantaged.

Table L7. Mann Whitney Test for Exercise Practitioner Work Setting

	Mean Rank		Z
	Hospital (*n* = 18)	Other (*n* = 36)	
Social influences	28.58	26.96	-.360
Goals	28.44	27.03	-.327
Reinforcement	24.42	29.04	-1.026
Behaviour regulation	25.11	28.69	-.833
Environmental context and resources	28.00	27.25	-.170
Beliefs about consequences	25.67	28.42	-.630