

RESEARCH IN HEALTH PSYCHOLOGY

RESEARCH THESIS

**THE ROLE OF SOCIAL CONNECTEDNESS IN TYPE 2 DIABETES DURING A
PANDEMIC**

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A portfolio of evidence submitted in partial fulfilment of the requirements of the University
of the West of England, Bristol for the degree of Professional Doctorate in Health
Psychology

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Table of Contents

Acknowledgements

Foreword: Undertaking the Professional Doctorate in Health Psychology

Declaration of contributions

Abstract	2
Introduction	3
Background and rationale.....	3
Type 2 diabetes.....	3
Self-management of type 2 diabetes.....	4
Psychosocial factors of self-management in type 2 diabetes.....	6
Literature review	9
Social connectedness.....	9
COVID-19 and social connectedness.....	11
Social support.....	14
Diabetes distress.....	19
Perceived competence	24
Theoretical framework.....	26
Application of SDT to diabetes management.....	29
The current study	32
Rationale for Measures.....	34
Research questions and hypotheses.....	35
Methods	37
Design.....	37
Survey testing and patient involvement	37
Recruitment and sample	38
Measures	40
Demographic questionnaire	40

Social connectedness scale – revised (SCS-R)	40
Diabetes self-management questionnaire (DSMQ)	41
Perceived competence in diabetes scale (PCDS)	41
Diabetes distress scale (DDS17)	42
Coronavirus (COVID-19)	42
Ethical considerations	43
Procedure	45
Data analysis	46
Results	47
Sample characteristics	47
Reliability analysis	48
Descriptive statistics	49
SCS-R.....	49
DSMQ.....	50
PCDS.....	52
DDS.....	53
DDS subscales	55
Regression analyses	57
Social connectedness and diabetes self-management.....	57
Social connectedness and perceived competence.....	59
Social connectedness and diabetes distress.....	61
COVID-19.....	63
Post-hoc mediation analysis.....	65
Discussion.....	66
Summary of findings	66
Social connectedness and diabetes self-management	67
Social connectedness and perceived competence in diabetes	70
Social connectedness and diabetes distress levels.....	71
Post-hoc mediation analysis.....	73
Impact of COVID-19.....	74
Strengths and limitations.....	76
Theoretical implications.....	78
Clinical implications.....	79

Future Research.....	80
Conclusions	81
References.....	84
Appendices.....	108
Appendix A: Ethics Approval	109
Appendix B: Participant Information Sheet	111
Appendix C: Participant Consent Form	114
Appendix D: Participant Debrief Sheet	115
Appendix E: Demographic Questionnaire	116
Appendix F: Social Connectedness Scale – Revised (SCS-R).....	117
Appendix G: Diabetes Self-Management Questionnaire (DSMQ).....	118
Appendix H: Perceived Competence in Diabetes Scale (PCDS).....	119
Appendix I: Diabetes Distress Scale (DDS-17).....	120
Appendix J: Participant COVID-19 responses.....	122
Appendix K: Flow diagram showing participant dropout.....	137
Appendix L: Systematic Review	138
Appendix M: Pilot survey testing email and responses.....	148

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Foreword: Undertaking the Professional Doctorate in Health Psychology

I have been undertaking the Professional Doctorate in Health Psychology at University of the West of England since November 2018, which has involved working towards and completing five areas of competency set out by the British Psychological Society.

Professional Skills in Health Psychology

has been completed and is awaiting assessment at the time of submission of the thesis. Work submitted includes a logbook evidencing supervised practice to meet required competencies and a reflective essay.

Teaching and Training in Health Psychology

has been completed, submitted, assessed and passed by the University of the West of England and the BPS examination board in November 2019.

Consultancy Skills in Health Psychology

has been completed, submitted, assessed and passed by the University of the West of England and the BPS examination board in November 2020.

Psychological Interventions Health Psychology

has been completed, submitted, assessed and passed by the University of the West of England and the BPS examination board in November 2020.

Research

The **Research** competency is assessed in two parts: a systematic review and empirical research.

A systematic review was conducted in 2019 during the first academic year on the professional doctorate and explored the effectiveness of psychosocial interventions at reducing hospital admissions among individuals living with diabetes. Diabetes is a chronic condition that when not managed effectively can lead to complications, often resulting in hospital admissions. The aim of the systematic review was to review evidence of the effectiveness of psychosocial interventions among individuals with elevated HbA1c (glycated

haemoglobin). Results indicated that psychosocial interventions are effective at reducing diabetes-related hospital admissions however only five studies were included in the final review and the methodological quality of studies was limited thus conclusions could not be drawn. The systematic review has been completed, submitted, assessed and passed by the University of the West of England and the BPS examination board in November 2019. The systematic review was later published in *Diabetic Medicine* (Moulson, Sanders, Coppin and Meyrick, 2020).

This doctoral thesis describes the research study conducted to fulfil part 2 of the research competency.

Declaration of contributions

All aspects of this research thesis were Hannah Moulson's own work.

Hannah Moulson was the lead researcher and provided the initial idea for this research and conducted the research design, recruitment, analysis and write up under the supervision of Tim Moss, Amy Slater and Kait Clarke.

RESEACH THESIS
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PANDEMIC

Abstract

Objective: To understand the role of perceived social connectedness in diabetes self-management, perceived competence, and diabetes related distress among adults living with type 2 diabetes in the UK during the COVID-19 pandemic. **Method:** The study utilised a cross-sectional design and was conducted online. Participants were 142 adults living in the UK with a diagnosis of type 2 diabetes. Participants completed self-report questionnaires to measure outcomes: social connectedness (SCS-R), diabetes self-management (DSMQ), perceived competence in diabetes (PCDS) and diabetes distress (DDS17). **Results:** Hierarchical multiple regression analyses were conducted and indicated that social connectedness is a significant predictor of diabetes self-management, diabetes distress, and perceived competence in diabetes. Regression results indicate that higher social connectedness levels are associated with a decrease in diabetes self-management, an increase in perceived competence in diabetes, and a decrease in diabetes distress levels among adults living with type 2 diabetes. **Conclusion:** The current study addresses a gap in research by exploring the role of social connectedness in type 2 diabetes. It is important to consider psychosocial factors in diabetes management and findings suggest that identifying and targeting social connectedness has the potential to improve outcomes. Further research should be conducted to extend our understanding of the role of social connectedness in diabetes and guide future interventions.

Introduction

Background and rationale

Type 2 diabetes

Diabetes is an increasingly common chronic physical health condition that has become one of the biggest global health issues due to its rapidly growing prevalence, affecting approximately 460 million people worldwide (International Diabetes Federation (IDF), 2020). In the United Kingdom (UK), it is estimated that 4.7 million individuals are living with diabetes, of which type 2 diabetes accounts for 90% despite being preventable (Diabetes UK, 2019). Type 2 diabetes is most common in adults, though is increasingly common in children and adolescents, and is a lifelong condition where insulin is unable to work effectively, or where the pancreas is unable to produce enough insulin, resulting in the level of sugar (glucose) in the blood becoming too high. Type 2 diabetes is often linked to inactivity, being overweight and/or having a family history of type 2 diabetes (Vivian, 2006; National Health Service (NHS), 2020). This differs from Type 1 diabetes which affects around 8% of those living with diabetes. In Type 1 diabetes, the body attacks cells in the pancreas which prevents it from making insulin. There is currently no known cause of type 1 diabetes, although it is usually diagnosed in childhood (NHS, 2019).

The rising prevalence of type 2 diabetes is a global concern, with the number of people living with diabetes in the UK expected to reach 5.5 million by 2030 (Diabetes UK, 2019). The World Health Organisation (2011) attribute the rising prevalence of type 2 diabetes to unhealthy lifestyle and behavioural patterns, along with ageing populations, urbanisation and rapid societal changes. Given the rapidly increasing prevalence of type 2 diabetes, it is important to consider the economic consequences. The cost of treating diabetes is increasing

and the NHS spends approximately £10 billion a year on diabetes, around 10% of its entire budget (Diabetes UK, 2019). This is a surprising figure, even more so when considering that more than half of all cases of type 2 diabetes could be prevented or delayed, and that 80% of the cost is spent treating diabetes-related complications such as cardiovascular disease, amputations and sight loss, which can often be prevented by effective self-management. Thus, the identification of effective strategies to improve self-management of diabetes among individuals living with type 2 diabetes is a priority to reduce complications and associated costs (Diabetes UK, 2019; Van Dieren et al., 2010; Hex et al., 2012).

Self-management of type 2 diabetes

In order to prevent diabetes-related complications as a result of suboptimal blood glucose control and maintain quality of life, self-management of type 2 diabetes is crucial (Shrivastava, Shrivastava and Ramasamy, 2013). Self-management is defined as an “individual’s ability to manage the symptoms, treatment, physical and psychological consequences of lifestyle change inherent with living with a chronic condition” (Barlow et al., 2002 p. 178). For those living with type 2 diabetes, achieving and maintaining recommended levels of glycaemic control is central to self-management and can delay or prevent the development of diabetes-related complications (Shrivastava et al, 2013). Successful self-management of diabetes requires knowledge of the condition and how to manage it including awareness of complications, screenings and the relationship between diet, activity and medications (Diabetes UK, 2009).

Glycaemic control is assessed regularly for those living with type 2 diabetes by measuring HbA1c levels. HbA1c refers to glycated haemoglobin, the level of glucose (sugar) in the blood. HbA1c is usually measured with a blood test every 2-3 months and provides an

indication of how well controlled blood glucose levels are. People living with type 2 diabetes are recommended to aim for a HbA1c level of 48mmol/mol (6.5%) or below, with levels higher than this indicating a higher risk of developing diabetes related complications (National Institute for Health and Care Excellence, 2020).

Achieving and maintaining recommended glycaemic levels is demanding and complex. It is estimated that contact with healthcare professionals for those living with diabetes accounts to a few hours per year, meaning that around 95% of diabetes management is self-management (Diabetes UK, 2009). There are a number of behaviours required for optimal glycaemic control whereby individuals living with type 2 diabetes are advised to perform daily self-management behaviours including taking oral medication, monitoring blood glucose levels, ensuring a balanced diet and ensuring adequate physical activity. Attending regular appointments with their healthcare team is also recommended to those living with diabetes and some individuals will be required to inject insulin to achieve recommended blood glucose levels (National Institute for Health and Care Excellence, 2018).

Diet: Making healthy food choices is recommended to manage type 2 diabetes and reduce the risk of complications. Individuals are advised to limit sugar, fat and salt in their diet and to include a range of fresh fruit and vegetables. (NHS, 2020a)

Exercise: Individuals living with type 2 diabetes are recommended to aim for two and a half hours of physical exercise per week to maintain blood glucose levels (NHS, 2020a).

Health checks: Those living with type 2 diabetes are advised to attend regular health checks to prevent complications and further health problems. This includes blood sugar checks every

3-6 months and foot checks every year to check for ulcers, infections and to prevent neuropathy. Yearly eye checks are also required to check for any damage to blood vessels to prevent diabetic retinopathy, as well as yearly blood pressure, cholesterol and kidney checks to prevent high blood pressure, heart and kidney disease (NHS, 2020a). In addition to health checks, although not recommended for all individuals with type 2 diabetes, many will require daily medication to manage their diabetes and some individuals are advised to monitor blood glucose levels by testing at home on a daily basis. For those where lifestyle modifications and oral medications are not sufficient to achieve target glycaemic control, insulin injections may be required (Marin-Penalver, Martin-Timon, Sevillano-Collantes and Canizo-Gomez, 2016).

Supporting self-management in diabetes is associated with positive outcomes including fewer consultations, a reduction in hospital admissions, improved quality of life and a better understanding of the condition which in turn increases independence and satisfaction (Diabetes UK, 2009).

The psychosocial factors of self-management in type 2 diabetes

Given the daily considerations one living with type 2 diabetes must make in order to manage their condition, it is perhaps unsurprising that there are often difficulties achieving the recommended levels of blood glucose and maintaining all components of recommended self-care. Although type 2 diabetes is a physiological condition with effective medication and management guidelines available, research suggests that less than 50% of those living with type 2 diabetes achieve the recommended glycaemic levels, thus increasing complications, mortality and cost to healthcare services (García-Pérez et al., 2013). It is well recognised that environmental, social, behavioural and emotional factors known as psychosocial factors play a key role in determining management outcomes among individuals living with diabetes, and

such factors often make implementing and maintaining self-management behaviours difficult (Gonzalez, Tanenbaum and Commissairat, 2018). When considering the role of psychosocial factors in the management of type 2 diabetes, it is understandable that the majority of individuals living with type 2 diabetes do not achieve optimal blood glucose control, subsequently leading to poorer health outcomes and diabetes related complications (Van Dieren et al., 2010; Hood, Hilliard, Piatt and Levers-Landis, 2015).

Managing diabetes is often perceived as interfering with living a 'normal' life (Paterson et al., 1998). Once an individual receives a diagnosis of diabetes, they are required to incorporate necessary requirements to self-manage the condition alongside their day-to-day life and other commitments. Peyrot et al. (2005) conducted an influential study aiming to identify attitudes, wishes and needs among individuals living with diabetes and healthcare professionals. A key strength of this study was that it included both patients and healthcare professionals across 13 countries in Asia, Australia, Europe and North America. The results suggested that there was a lack of self-management behaviours and high levels of diabetes related distress, with 41% of individuals living with diabetes reporting poor psychological wellbeing affecting self-management including diabetes-related worries. As a result of the findings, five goals were identified including the need to promote self-management among those living with diabetes, enhancing psychological care for those living with diabetes, and to enhance communication between people with diabetes and healthcare professionals. It is important to consider that individuals with both type 1 and type 2 diabetes were included in this study, however it provides convincing evidence to support the significance of psychosocial difficulties among those living with diabetes worldwide.

A follow up study was conducted a decade later (Funnell, Bootle and Stuckey, 2015) to build

on findings from the original research and to determine whether progress had been made with regards to diabetes care and self-management. Similar to the original study in 2005, both people living with diabetes and healthcare professionals were recruited from 17 countries across four continents to provide a representative sample of the diabetes population. Funnel et al found that self-management behaviours among individuals living with diabetes were still suboptimal, largely due to psychosocial issues including diabetes related distress. Results indicated that little had changed, and that diabetes care and self-management continue to be lacking. Findings reinforce the message that further work needs to be done for healthcare professionals to better understand the priorities, psychosocial needs and goals of those living with diabetes.

The need for psychosocial factors to be considered alongside glycaemic control was emphasised by Fisher, Gonzalez and Polonsky (2014), who argue for the need to move away from viewing the emotional and physical aspects of diabetes separately. This notion is also supported by Young-Hyman et al. (2016) who suggest that for successful management of diabetes, lifestyle and emotional factors should be taken into consideration and psychosocial care should be integrated with medical care to optimise outcomes and improve quality of life. Achieving a better understanding of psychosocial aspects of living with diabetes has become a priority (IDF, 2019), and there is a growing body of literature aiming to increase awareness and improve understanding.

In summary, type 2 diabetes is an increasingly prevalent condition impacting millions of people in the UK and worldwide. Self-management of type 2 diabetes through monitoring, and lifestyle changes is important to manage blood glucose levels and prevent diabetes-related complications, which are costly to both the individual and the healthcare system when

considering both the impact on quality of life and the economic burden of managing and treating the condition. However, it is important to acknowledge the psychosocial factors influencing self-management and approach diabetes care and management from a biopsychosocial approach, considering psychosocial factors in addition and alongside the physiological aspect of diabetes (Engel, 1977).

The following literature review will explore the concepts under investigation, providing context for the current study.

Literature Review

Social Connectedness

Social connectedness is defined as the experience of belonging and plays an important role in both physical and mental health (Lee and Robbins, 1995; Cryuwys et al, 2014). Individuals evaluate their relationships and assess the extent to which they feel socially connected, and whilst social connectedness is indicated by feelings of caring for others, feeling cared for and feeling a sense of belonging to a group or community, socially 'disconnected' individuals may experience loneliness and a desire for connection (O'Rourke and Sidani, 2017; Lee and Robbins, 1995). It is postulated that individuals with high levels of social connectedness are likely to feel closer to others, identify with others more easily and participate in social groups and activities. In contrast, individuals with low levels of social connectedness are more likely to experience psychological distress, evaluate their relationships more negatively and struggle with intimacy and sociability (Lee, Draper and Lee, 2001). There is strong evidence that social connectedness is positively associated to wellbeing. Lee and Robbins (1998) explored the relationship between social connectedness and anxiety, self-esteem and social identity among women and found that social connectedness was related to increased self-esteem and

lower levels of anxiety. A later study (Lee, Draper and Lee, 2001) supported these findings, reporting that social connectedness was significantly associated with decreased psychological distress. The positive influence of social connectedness on wellbeing were further replicated by Mauss et al., (2011).

In addition to psychological wellbeing, feelings of interpersonal closeness and belonging can be an important factor in physical health outcomes and quality of life. Research has found that social connectedness has an important role in health and wellbeing (Ashida and Heaney, 2008; Kleynshteyn, 2013; Crotty et al, 2015; Pryce, Moutela, Bunker and Shaw, 2019; Southwick and Southwick, 2020; Taylor et al., 2020). Research from adults across 11 European countries revealed that higher rates of social participation may improve health status within most countries (Sirven and Debrand, 2008). Whilst data were self-reported and only included adults aged fifty and over thus limiting generalisability somewhat, the large sample from multiple counties provides evidence for the importance of social connection in health outcomes. A later meta-analysis of 148 studies found that the more socially disconnected people were, the more likely they were to develop cardio-metabolic diseases including diabetes (Holt-Lunstad, Smith and Layton, 2010). The findings also suggested that social connectedness was underestimated by healthcare professionals as a health-risk factor, which Sonderlund et al., (2019) argue is still an issue.

Turning to the relationship between social connectedness and type 2 diabetes, literature highlights the importance of social connection for health and wellbeing, suggesting that social connectedness is associated with health status (Seppala, Rossomando and Doty, 2013). There is evidence to suggest that social isolation is associated with type 2 diabetes, and

previous research has found that a lack of social contact and support is associated with an increased risk of a diagnosis of type 2 diabetes (Brinkhues et al., 2017).

For individuals living with long-term conditions, such as diabetes, the ability to maintain social connections or indeed to develop new ones may be difficult. Reeves et al (2014) found that among those living with heart disease or diabetes, social involvement supported self-management and both physical and psychological wellbeing. Reeves et al argue for greater focus on the importance of social involvement as a cost-effective way of supporting the management of long-term conditions. These findings were supported by a later study exploring types of social networks in relation to long term condition management among people living with type 2 diabetes in six European countries (Vassilev et al., 2016) which found an association between increased social involvement and self-management of long-term conditions as well as lower healthcare costs. However, findings varied across the six European countries and participants were from predominantly marginalised and deprived settings limiting generalisability to the wider population of individuals living with type 2 diabetes. Despite existing research, there continues to be a lack of understanding of the impact of social connection on the management of type 2 diabetes thus by understanding how perceived social connectedness influences diabetes self-management, it will provide an important insight into how individuals living with type 2 diabetes can best be supported.

COVID-19 and Social Connectedness

To build an understanding of social connectedness and its role in type 2 diabetes, it is important to consider the current context of the coronavirus 2019 (COVID-19) pandemic on those living with type 2 diabetes and in particular to consider the increased risk posed to

individuals living with diabetes, and the influence this may have on perceived levels of social connectedness and diabetes management. Furthermore, COVID-19 continues to have an impact in many ways on an individual and societal level thus understanding the effect this may have for those living with diabetes now and in the future will help healthcare providers support individuals and adapt diabetes care. As discussed, previous research has highlighted the positive impact of social connection on our health and wellbeing and is particularly important when experiencing uncertainty and distress (Nitschke et al, 2021). In the UK, various restrictions were put in place to mitigate the transmission of COVID-19 including self-isolation, shielding whereby the most vulnerable were asked not to leave their homes for any reason due to increased risk of severe illness from COVID-19, and restrictions on socialising with family and friends including social distancing. Such measures may influence an individual's sense of social connectedness thus impacting physical and psychological wellbeing.

Although current research on COVID-19 and diabetes is limited and inconclusive, there is indication that those living with diabetes are at increased risk of infection and severe illness as a result of COVID-19 (Huang et al, 2020). Research also suggests that COVID-19 is associated with worse outcomes in people with diabetes (Hartmann-Boyce et al, 2020). Interestingly, an observational study in Italy found that the COVID-19 lockdown did not significantly impact glycaemic control in individuals with type 2 diabetes (D'Onofrio et al, 2021), however another study conducted in Italy found there was an increase in glycaemic levels among 26% of patients and similar findings were also seen in India (Biancalana, Parolini and Mengozzi, 2020; Khare and Jindal, 2020).

Moreover, those living with diabetes appear to be more negatively impacted by COVID-19 even if they are not infected with the virus, for example due to having to shield, health service disruption and increased perceived risk (Schofield, Leelarathna and Thabit 2020). Research has found that adolescents experienced isolation and loneliness due to disruption in their daily lives as a result of the COVID-19 pandemic, and that the reliance on household members for social connection posed an increased risk of loneliness to those living alone compared to those living in larger households (Burrai et al, 2021; Okabe-Miyamoto, Folk, Lyubomirsky and Dunn, 2021). Whilst this research was not specific to those living with type 2 diabetes, it highlights the impact of isolation during the pandemic and the likely benefits of increased social connection. Considering the psychosocial impact of COVID-19 on individuals living with diabetes, research suggests that individuals living with diabetes are at increased risk of psychological distress related to the pandemic which may result in worsening glycaemic control and continued difficulties with self-management (D'Onofrio et al, 2021). Diabetes related worries have also been found to be strongly associated with lack of social support during COVID-19 (Sujan et al, 2021).

The positive impact of social connectedness on mental health during the COVID-19 pandemic has been documented in recent research including reduced levels of distress and fatigue (Liotta et al, 2020; Nitschke et al, 2020; Yıldırım et al, 2021). However, data from this research cannot determine the direction of relationship between distress and social connectedness thus further research is needed to understand the directionality of associations. Nevertheless, results highlight the role of social connectedness in reducing negative physical and mental health outcomes, particularly in times of uncertainty such as COVID-19. It is, therefore, important to consider the likely impact of COVID-19 on social connectedness among those living with type 2 diabetes, particularly given the increased vulnerability and

likelihood of shielding which is likely to increase isolation and decrease opportunities for social connection.

Social support

Whilst there is a lack of research on social connectedness among those living with type 2 diabetes, there is a large body of research exploring the role of social support in the context of general wellbeing which can provide further insight into the role of social connection and support in health behaviours. Social support is defined as an ‘exchange of resources between at least two persons, aimed at increasing the wellbeing of the received’ (Shumaker and Brownell, 1984). It is an experience involving both formal and informal relationships with others whereby one is provided with support from certain individuals, or a group (Badarch, Tarasenko and Schoenborg, 2011; Strom and Egede, 2012).

The role of social support in type 2 diabetes management has been highlighted in previous research and findings suggest that diabetes self-management is most effective when it occurs in the context of close and supportive relationships, and that social support is associated with increased adherence among individuals living with type 2 diabetes experiencing psychological distress (Wiebe, Helgeson and Berg, 2016). DiMatteo (2004) conducted a meta-analysis on 122 studies and found that adherence was higher in those that are living with another person, married and from a ‘cohesive’ family suggesting that having a stable support network may have a positive impact on adherence to medical regimens. Furthermore, research has shown that support plays a significant role in successful lifestyle change among individuals living with type 2 diabetes as it is associated with increased self-efficacy, more positive diabetes-related attitudes, and improved glycaemic control (Shao et al, 2017; Lee, Piette, Heisler, Janevic and Rosland, 2019). Mayberry and Osborn (2012) explored the

relationship between perceptions of family members' knowledge around diabetes care, supportive behaviours, and medication adherence among adults living with type 2 diabetes and glycaemic control. A mixed methods approach using focus groups and self-report questionnaires found that individuals who perceived family members to be knowledgeable about diabetes care also perceived them to be supportive whereas those who felt family members were unsupportive were found to be less adherent to medication and had poor glycaemic control. Results suggests that social support plays an important role in diabetes self-management, however as participants in this study were recruited from a single site there are limitations to generalisability. Despite such limitations, the mixed methods approach provides an important insight into the role of family support in diabetes care and useful information to consider when developing interventions.

Social support is also reported to have a positive impact on psychological wellbeing among those living with type 2 diabetes. Aikens et al (2015) found that individuals living with type 2 diabetes in the United States who were nonadherent to treatment and experiencing psychological distress may benefit from support via telemonitoring. These findings provide support for the beneficial impact of social support to improve diabetes self-management when an individual is experiencing distress. A limitation to consider for this study, however, is that participation in the intervention with a support person was determined by individual preference rather than random assignment thus there may be extraneous variables influencing results. Nevertheless, findings are consistent with previous research reporting increased levels of social support are associated with improved physical and mental wellbeing in older adults living with type 2 diabetes (Gallegos-Carrilo et al, 2009). Furthermore, more recent research found that social support reduced diabetes related distress and that low satisfaction with social support is associated with more severe diabetes distress compared to moderate or

high satisfaction (Chan et al, 2020; Presley et al, 2020). These recent findings provide further support for the importance of social support in self-management in diabetes and also psychological wellbeing among individuals living with diabetes.

A systematic review (van Dam et al, 2015) of social support focused interventions on self-care and health outcomes in type 2 diabetes found that specific social support interventions do indeed affect outcomes in individuals living with type 2 diabetes. However, interventions were found to have great heterogeneity and social support was also found to have a negative impact in some cases, for example spouse participation was found to have a negative effect in obese men with diabetes (Wing, Martin and Epstein, 1991). This systematic review overall supports the effectiveness of social support interventions for diabetes outcomes and self-management however it is important to consider that the review only included a small number of studies and did not clarify which aspects of social support were most effective at improving self-management. Furthermore, across studies social support was defined and measured in various ways limiting generalisability. Nevertheless, it builds on other research to highlight the importance of social support interventions and consideration in diabetes care for individuals with type 2 diabetes. Despite evidence pointing to the effectiveness of social support in diabetes care, a previous review found that there has been a lack of implementation (Kadirevlu, Sadasivan and Ng, 2012). There is a possibility that social support has a more significant role in certain self-management behaviours than others in diabetes care. Rosland et al. (2008) analysed survey data from 164 African-American Latino adults living with type 2 diabetes in Detroit and found that the association between friend and family support and diabetes self-management behaviour was stronger for monitoring blood glucose levels compared to other self-management behaviours. Furthermore, professional support and diabetes self-efficacy were associated with different self-management behaviours

suggesting that depending on the target self-management behaviour, different mechanisms may be more effective. These results provide an interesting insight and an important consideration when developing and implementing self-management interventions, however it is important to note limitations to generalisability due to a small sample size and participant demographics.

In addition to social support research in diabetes, research exploring the impact of loneliness can provide further understanding around the role of support and connection in the management of health conditions such as type 2 diabetes. Loneliness is found to impact self-management ability indicating the importance of considering loneliness in care planning, particularly for those who struggle with self-management of chronic illness (Theeke et al, 2019; Warner et al., 2017). Whilst both these studies explored the impact of loneliness on management of chronic illness in general rather than diabetes thus limiting generalisability to adults living with type 2 diabetes in particular, findings provide support for the importance of social support in the management of long-term conditions such as type 2 diabetes as discussed. Hackett, Hudson and Chilcot (2020) found that loneliness is a risk factor for type 2 diabetes in a longitudinal study. This association was independent of social isolation and living alone suggesting that diabetes prevention strategies should focus on quality of social relationships rather than the quantity. Although this study was observational and therefore cannot infer causality, it was conducted over a twelve-year period with a nationally representative sample, providing convincing support for the need to consider social factors in diabetes management. Nevertheless, it is important to note that whilst social support has been found to have a positive impact on self-management among those living with diabetes, some studies have found that there can be negative impacts and that social support can in fact act as a barrier to self-management (Miller and Dimatteo, 2013).

Previous research has not always distinguished between social support and social connectedness however it is important to consider the constructs separately. Rook (1990) makes this distinction, highlighting that social relationships do not necessarily involve the exchange of social support and that an individual may feel socially disconnected despite having a companion or what is perceived as social support. Relationships between individuals without support exchange can still have a positive influence on individuals if the need for social connectedness is satisfied. In contrast to social support, social connectedness is subjective and relates to an individual's perception of isolation however research is limited, and previous studies have not always considered social support and social connectedness separately (Crotty et al., 2015; Ashida and Heaney, 2008). Past studies have found that social connectedness is associated with health and wellbeing independently of social support and benefits of social connectedness are maintained independent of perceived social support (Rook, 1987; Lee and Robbins, 1998). Thus, it is possible for individuals to feel socially connected in the absence of sources of social support. Similarly, an individual may have access to numerous sources of support yet feel socially disconnected. Ashida and Heaney (2008) conducted interviews with older adults and found that having a social network in close proximity was positively associated with social connectedness and perceived levels of social connectedness had a positive association with health status whereas social support did not. These findings support the view that perceived social connectedness may be more important to health and wellbeing than the perceived availability of social support, however participants in this study were recruited from an urban community with a small number of minority residents thus some results may not be generalisable to different socioeconomic and cultural backgrounds. Whilst it is important to make the distinction between social connectedness and social support, the existing literature on social support among individuals living with type 2

diabetes provides a picture that feeling supported by and connected to others has a positive impact on wellbeing and health outcomes. The current study aims to build on current knowledge and understand whether a sense of belonging and feeling of connection to others and the social world has an impact on psychological wellbeing and self-management among individuals living with type 2 diabetes.

Diabetes distress

Considering psychological wellbeing alongside physical health outcomes in those living with type 2 diabetes is crucial. There is now a large body of literature and increased awareness among healthcare professionals that diabetes has an impact not only on an individual's physical health but also their mental wellbeing. As previously discussed, the majority of people living with diabetes are required to make significant adjustments to their lifestyle to incorporate responsibilities necessary to manage the condition, thus it is not surprising that living with diabetes can negatively impact an individual's mental wellbeing and quality of life (Funnell and Anderson, 2004). At least 4 in 10 people living with diabetes experience psychological difficulties including diabetes-related emotional distress which reduces their ability to manage their diabetes, consequently leading to poorer health outcomes and an increase in healthcare costs (Mental Health Taskforce, 2016).

Wang et al. (2016) explored the associations of changes in diabetes distress with various psychosocial factors in a longitudinal study and found that increases in diabetes self-efficacy was significantly associated with decreased diabetes distress. This is supported by a later study which found self-efficacy moderates the association between diabetes related distress and self-management behaviours (Jiang et al., 2019). Diabetes distress refers to emotional distress specifically related to living with and managing diabetes, often as a result of

becoming overwhelmed with the demands (Fisher, Gonzalez and Polonsky, 2014). Fisher et al. suggest that diabetes distress can be caused by one or more of three inter-related stressors: distress related to diabetes and its management such as fear of complications, distress due to other life stressors such as work or financial worries, and distress related from other causes such as personal characteristics or life history. Diabetes distress is common regardless of type of diabetes however literature suggests that age, gender, and treatment are associated with levels of diabetes distress. Individuals who are younger, female, non-white, and treated with insulin rather than oral medication are found to have higher levels of diabetes distress (Delahanty et al., 2007).

Many individuals living with type 2 diabetes experience diabetes distress, and research has found that even at low levels, diabetes related distress is associated with elevated HbA1c and a decline in self-management as individual's experience 'diabetes burnout', increasing the risk of diabetes-related complications, hospital admissions and related healthcare costs (Fisher et al 2010; Tareen and Tareen, 2017). This is supported by more recent findings from Amankwah-Poku et al., (2020) which suggest diabetes distress is negatively associated with dietary and exercise behaviours, though is associated with increased glycaemic levels, indicating poor control. However, these authors acknowledge that the majority of participants included in the study had well controlled blood glucose levels suggesting a lower burden of diabetes in those who took part thus results may not be generalisable to individuals with increased glycaemic levels as a result of sub optimal management. Another recent study (Kretchy et al, 2020) found that diabetes distress is a significant determinant of medication adherence among those living with type 2 diabetes and suggest that screening for diabetes distress should be a standard part of diabetes care. Participants in this study were only recruited from one hospital therefore results may not be representative, and causality cannot

be established due to the cross-sectional approach. Nonetheless, findings support previous research to suggest that diabetes distress is likely to have a negative effect on diabetes self-management among those living with type 2 diabetes.

Although the importance of psychological and emotional support for individuals living with diabetes is acknowledged at a national level and is reflected in guidelines, the majority of diabetes services in the UK do not routinely assess psychological adjustment (Holt, 2018). The National Institute for Health and Care Excellence (NICE) recommends that adults with diabetes are assessed for psychological problems (NICE, 2011) and these recommendations are also reflected in research. Karlsen et al. (2012) suggest that healthcare providers should consider non-clinical factors such as social support when addressing diabetes distress following findings that a greater variance in emotional distress was accounted for by coping styles and perceived support than clinical indicators. Generalisability of these findings are limited due to self-reported data including HbA1c and the cross-sectional design of the study, however findings offer an insight into the importance of considering factors beyond glycaemic control. Findings indicate that when choosing interventions aimed at reducing distress and when working to understand factors related to diabetes distress, it is important to consider that such interventions may not be the same as interventions aimed at improving glycaemic control.

As previously mentioned, the influential Diabetes Attitudes, Wishes and Needs (DAWN) study conducted by Peyrot et al. (2005) found that healthcare professionals reported whilst they generally felt able to recognise worries among individuals, there were a lack of resources to manage them with only a small minority of patients receiving psychological support. The follow up study (Funnell et al., 2015) highlighted that changes in the healthcare

system had not yet been adequate to support those experiencing such difficulties and address the emotional needs of individuals. Findings from both studies again reinforce the need for better understanding and resources among healthcare professionals to understand and support the psychosocial needs of those living with diabetes and highlight the gaps in availability of such support. Davies (2019) also highlights that despite numerous guidelines to emphasise the importance of increasing psychological support for those living with diabetes, service improvements to date have been limited.

Previous research has not explored the role of social connectedness in diabetes distress however past studies have provided evidence for the role of social support in reducing levels of diabetes distress, with lack of social network and social support such as living without a partner and perceived lack of help from others being associated with higher levels of diabetes distress. Ramiksson et al (2017) found that an increase in social support is associated with lower levels of emotional distress and increased wellbeing among adults living with type 2 diabetes in South Africa. Interestingly, whilst Ramiksson et al found that social support plays an important role in coping with diabetes and improving adherence to treatment they did not find an association between social support and glycaemic levels in contrast to other findings (Chida and Hamer, 2008; DiMatteo, 2004). However, results point to the importance of social support in helping individuals manage the psychological impact of living with diabetes which again highlights the need for healthcare professionals to consider psychosocial factors in diabetes care.

Findings highlighting the importance of social support for psychological wellbeing is supported by prior research which found frequent contact with friends is found to be associated with fewer psychosocial difficulties and a more positive appraisal of care and self-

management behaviour in a large sample of 2572 of individuals living with type 2 diabetes (Schjøtz et al, 2012). Further evidence for the benefits of social support on diabetes distress levels is highlighted in a recent study (Young et al, 2020) which found that higher levels of perceived social support among adults living with type 2 diabetes was associated with lower levels of diabetes related distress. Support satisfaction and number of supports has been found to significantly moderate the relationship between diabetes burden and distress among adults with type 2 diabetes, supporting the notion that social support may protect against diabetes distress (Baek, Tanenbaum and Gonzalez, 2014). A more recent study (Beverly, Ritholz and Dhanyamraju, 2021) supports these findings, as social support was found to play a buffering role among adults with both type 1 and type 2 diabetes by decreasing diabetes distress and depressive symptoms. Furthermore, social support buffered the relationship between diabetes distress and self-care. However, due to the predominantly white sample generalisability may be limited, and authors highlight that participants with low health literacy or lack of access to internet were less likely or unable to take part which again limits generalisability to the wider population of adults living with diabetes.

Despite a growing body of research in the field of diabetes distress, it is still a relatively new concept and whilst there is strong evidence to suggest a link between diabetes distress and self-management, it is important to build on existing research to understand how individuals experiencing diabetes distress can be supported, and how it might be influenced.

Understanding the role of social connectedness in diabetes distress will add to what is already known and in particular will provide an insight into whether social connectedness can support individuals manage the physical and psychological demands of living with type 2 diabetes at a time of uncertainty and increased vulnerability.

Perceived Competence

Perceptions of diabetes management as ‘uncontrollable’ have been found to have a negative impact on self-management as well as being associated with increased diabetes distress (Macrodimitis and Endler, 2001), stressing the importance of individuals feeling confident in their ability to achieve desired outcomes i.e., optimal blood glucose levels in the management of type 2 diabetes. How an individual perceives their ability to perform a task and achieved desired outcomes is referred to as perceived competence and plays a key role in wellbeing (Deci and Ryan, 1985). Individuals experience a sense of competence when they believe they are able to control important health outcomes. People living with diabetes perceive themselves to be competent when they feel personally able to control important outcomes such as maintaining their blood glucose levels in a healthy way (Williams, McGregory, King, Nelson and Glasgow, 2005). Thus, by improving the perceived competence of individuals living with type 2 diabetes, self-management may be improved, reducing complications and associated healthcare costs.

The importance of perceived competence in diabetes management has been highlighted in numerous studies as research shows perceived competence is significantly associated with lower depressive symptoms, improved glycaemic control and better patient satisfaction (Williams et al., 2004; Williams et al., 2005). These findings suggest the need to consider patient competence, satisfaction and depressive symptoms in addition to glycaemic control and that healthcare professionals should be trained to consider such factors when working to improve diabetes outcomes. The impact of competence on diabetes related distress was also explored by Mohn et al. (2015), who found a significant negative relationship between perceived competence and Problem Areas In Diabetes (PAID) scores, suggesting that lower levels of perceived competence is associated with higher distress levels. These findings

support those of Macrodimitris and Endler (2001), however it is important to note that participants in this study had type 1 diabetes thus results may not be generalisable to individual's with type 2 diabetes. Nevertheless, it provides valuable information regarding the relationship between perceived competence and experiences of those living with diabetes. A more recent study found that a negative appraisal of diabetes predicted higher blood glucose levels whereas greater perceived competence predicted lower blood glucose variability among individual's with type 2 diabetes (Mellergård and Johnsson, 2020). It is therefore suggested that self-management of type 2 diabetes is enhanced when individuals perceive themselves to have the necessary skills to manage the condition. Williams et al, (2009) aimed to understand medication adherence among those living with diabetes by applying the SDT. They found that perceived competence was positively related to quality of life and medication adherence, and that the SDT proved to be a good fit to predict medication adherence, quality of life and physiological outcomes in the context of diabetes management. This research provides further support for the link between perceived competence and glycaemic control and again highlights the need for healthcare professionals to work with individuals to support patient autonomy and competence which in turn helps individuals to build self-management skills and enhances medication adherence among those living with type 2 diabetes.

Whilst there is no current direct research exploring the role of social connectedness in perceived competence, there is evidence to suggest an increase in social connectedness is related to an improvement among self-efficacy, defined as the belief in one's capability to perform specific behaviours (Dobbins et al 2020; Bandura, 1977). Research exploring the role of self-efficacy, outcome expectancy and social support in self-care behaviour of people living with diabetes found that self-efficacy was positively associated with self-care activities

including diet, exercise and testing of blood glucose levels (Williams and Bond, 2010).

Whilst this study explores self-efficacy rather than perceived competence in diabetes specifically, the results suggest that interventions designed to increase an individual's confidence in managing their diabetes care are likely to be effective. However, given the cross-sectional design of the study no conclusion around causality can be drawn.

Furthermore, these findings suggest that an increase in social connectedness and social support is associated with an increase in ones' belief to perform specific behaviours.

Research in self-efficacy therefore provides a helpful insight into the possible role of support and connectedness in diabetes related competence, however it is important to distinguish between self-efficacy and perceived competence in the context of health behaviours and not to use the terms interchangeably. Whilst self-efficacy refers to an individual's belief in their capability to perform a behaviour, perceived competence includes consideration of the personal importance of a particular task (Bandura, 1997; Rodgers et al., 2014). As previously highlighted, it is important to consider psychosocial factors alongside objective measures such as glycaemic control to effectively support self-management. The current study explores the role of social connectedness in perceived competence in diabetes, thus understanding perceived competence to engage with diabetes self-management behaviours will improve understanding of how individuals living with type 2 diabetes can be supported.

Theoretical framework

As discussed, diabetes self-management is essential for achieving and maintaining optimal blood glucose control. The importance of motivation in health behaviours is widely accepted (Rodgers and Loitz, 2009; Guertin et al, 2015; Hardcastle et al., 2015) and for individuals living with type 2 diabetes it is critical for effective self-management. Supported self-management is part of the NHS Long Term Plan with the aim to support individuals living

with long term conditions to build knowledge, skills and confidence to manage their condition, recognising that supporting self-management increases the likelihood that individuals will adopt behaviours that support their health and wellbeing (NHS, 2020b). Thus, increasing and supporting individuals' self-determination and motivation to self-manage their condition is key for healthcare professionals.

The current study is best viewed from the perspective of the self-determination theory (SDT) proposed by Deci and Ryan, (1985). The SDT provides a theoretical framework for understanding the psychological requirements for self-determination and can be usefully applied to the self-management of diabetes to understand motivation to engage in the required self-management behaviours as discussed. The SDT assumes that humans have an innate tendency to pursue growth, well-being and health and proposes three basic psychological needs; autonomy, competence and relatedness, suggesting that humans are motivated when these needs are fulfilled. The SDT was felt to be a better fit for this study than other theories, such as self-efficacy theory (Bandura, 1997) which focuses only on self-efficacy as the primary driver of motivation to engage in specific behaviours whereas SDT considers the need for a sense of belonging and autonomy in addition to feeling able to carry out such behaviours.

According to the SDT, autonomy refers to an individual's active choice for performing an action and willingness to perform such actions because they're consistent with their sense of self. According to the SDT, an individual feels autonomous when they regulate their behaviour volitionally (i.e., with choice and self-endorsement). As individuals become more autonomously motivated, they feel more competent and better able to attain outcomes. Thus, individuals living with diabetes would feel autonomous if they took medication because it

was important to them rather than because they have been told to by a healthcare professional (Deci and Ryan, 2000; Williams et al, 2009). Competence is when an individual is capable of achieving the desired outcomes by developing new skills (Deci and Ryan, 1985). Research has shown that individuals are more likely to develop necessary skills to manage their health if they personally endorse those behaviours thus when people feel autonomous, they are more likely to feel competent to achieve health outcomes (Williams and Deci, 1996; Williams et al., 1998; Williams et al., 2004; Williams et al., 2009). Relatedness refers to the need to experience a sense of belonging or attachment to other people. According to the SDT, individuals have a need to connect to and be accepted by others. The need for relatedness can be fulfilled when one perceives themselves as being included in a group, as having close relationships with others and feeling a sense of belonging (Deci and Ryan, 2000). Although someone can be motivated to do something based solely on autonomy and competence, relatedness is an imperative need regardless as the absence of relatedness is likely to lead to a failure in the emergence of motivation according to Deci and Ryan (2000). It is therefore important to understand how feeling connected and related to other individuals and groups may influence one to achieve positive and optimal outcomes. This study will explore the concept of relatedness through the measure of social connectedness in relation to diabetes outcomes.

The SDT differs from other theories of human behaviour in that it views motivation as psychological energy directed towards a specific goal, emphasising the importance of quality of motivation rather than quantity alone whereas many other theories explain the direction of behaviour but neglect how that behaviour is energised (Deci and Ryan, 1985). It recognises that encouraging persistent behaviour change not only requires the knowledge and skills for change but also autonomous motivation and self-determination (Yun et al, 2020). The SDT is

centred on the belief that people have ‘inherent growth tendencies’ to behave in healthy and effective ways and that the needs of autonomy, competence and relatedness will impact their performance (Hood et al, 2015). It is of course important to consider the impact of sociocultural context on these needs, and Ryan and Deci (2000) highlight that individuals are likely to express these needs differently within cultures and hold different values. Research has tested the SDT across cultures and indeed supports the hypothesis that individual’s are more motivated to act when these three needs are met (Church et al, 2013).

When considering limitations of the SDT, it has received criticism for having a too idealistic view of human behaviour that overlooks darker sides of human behaviour (Pyszczynski, Greenberg and Solomon, 2000). Ryan and Deci (2000) argue that the SDT does in fact account for individual differences in explaining darker sides of human behaviour and highlight that such differences can regularly be traced to disruptions of basic psychological needs during development. Pyszczynski et al (2000) also question why SDT focuses only on three needs, however it is the view of SDT (Ryan and Deci, 2000) that the usefulness of the theory comes largely from the fact that they can be applied generally across multiple domains of human experience which they argue is not possible when there are a larger number of needs. It could be argued that SDT focuses too heavily on autonomy, neglecting relatedness and competence however Ryan and Deci (2000) provide rationale for this, explaining that autonomy had been the most neglected hence a stronger focus on the need for autonomy but that they do not believe it is more important for wellbeing.

Application of SDT to diabetes management

The SDT was developed in the context of social science focusing on theory development and intrinsic motivation and has only been applied to health behaviours in more recent years with

research showing that SDT based interventions can be applied to various health behaviours (Deci and Ryan, 1985; Patrick and Williams, 2012). There have been numerous studies applying SDT to diabetes management, in particular exploring the needs of autonomy and competence to understand self-determination in self-management among individuals living with diabetes. Williams et al. (2009) applied a SDT model of health behaviour to predict medication adherence, quality of life and physiological outcomes among adults living with type 2 diabetes in Michigan and found that individuals are more likely to feel competent to accomplish outcomes when they feel autonomous. These findings built on previous longitudinal studies showing a link between perceived competence and improved glycaemic control (Williams, Freedman and Deci, 1998; Williams et al., 2004), providing support for the SDT applied to diabetes. Furthermore, an autonomy supportive environment is associated with lower levels of distress related to living with diabetes, increased self-efficacy for diabetes self-management and improved medication adherence (Williams, Lynch and Glasgow, 2007; Williams et al, 2005; Williams et al., 2009).

Later research utilising SDT as a model for diabetes self-management among individuals living with type 2 diabetes supports these findings. A qualitative study (Karlsen et al., 2018) found that a self-determination programme had a positive influence on participants' motivation for self-management, highlighting the benefits of strengthening self-determination among individuals living with type 2 diabetes with the aim to support self-management. Prior to this research there was a lack of knowledge around how those living with type 2 diabetes experience such interventions, therefore these findings provide a qualitative insight to support previous research and highlight the importance of increasing self-determination.

A more recent study (Grønnegaard et al., 2020) investigated a SDT based model in Danish adults living with type 2 diabetes to test the hypothesis that autonomy support from

healthcare professionals determines autonomous motivation and perceived competence in diabetes. Of the 116 participants, results found that autonomy support was in fact significantly correlated with perceived competence and motivation. Furthermore, perceived competence had a negative correlation with diabetes related distress and was positively associated with diabetes self-care. However, although this recent study adds to the literature in the field and supports previous research, it is important to note that findings are mainly generalisable to individuals with poor glycaemic control and lower educational level thus further research applying SDT to adults living with type 2 diabetes is needed. Nevertheless, this study contributes further knowledge of the utility of the SDT as a theoretical framework in the context of type 2 diabetes. There is a lack of research exploring the role of relatedness in diabetes self-management, however a recent study reported that social support and relatedness appeared important for maintaining lifestyle changes and self-management in diabetes with adherence to new lifestyle changes becoming vulnerable when relatedness was affected due to changes in relationships and social states (Schmidt, Hemmestad, MacDonald, Langberg and Valentiner, 2020).

When considering psychological outcomes among those living with type 2 diabetes from an SDT perspective, research has found that autonomy support is associated with increased perceived competence which in turn was associated with reduced distress (Mohn et al., 2015). These findings indicate that enhancing perceived competence through autonomy support may contribute to effective treatment among those living with diabetes and empower individuals. The link between perceived competence and diabetes distress is supported by a recent study which found perceived competence mediated improvements in diabetes distress and HbA1c levels, indicating the benefit of aiming to increase perceived competence in interventions to reduce diabetes distress levels (Mizokami-Stout, Choic, Richardson, Piatt and Heisler, 2021).

To summarise, The SDT provides a theoretical framework for understanding the psychological requirements for motivation, suggesting that the motivation to engage in a given behaviour flourishes if competence, autonomy and relatedness are satisfied. Previous research provides support for the application of SDT in diabetes management and highlights the role of autonomy and competence, as well as the relationship between autonomy and competence (Williams et al., 1998; Williams et al., 2004; Williams et al., 2009; Karlsen et al., 2018; Grønnegaard et al., 2020). According to the SDT, therefore, individuals living with type 2 diabetes are more likely to engage in self-management behaviours such as taking medication if the basic needs of autonomy, competence and relatedness are supported.

The current study

The SDT proposes that without autonomy, competence and relatedness individuals will not be motivated to engage in diabetes self-management behaviours (Deci and Ryan, 1985). Research on relatedness is more limited than the other principles of SDT (competence and autonomy), particularly in relation to health outcomes thus there is limited understanding on the role of relatedness in diabetes management, for example whether those who experience a sense of belonging demonstrate more effective diabetes self-management than those who do not. Relatedness is defined as the need to experience a sense of belonging or attachment to other people. The current study explores relatedness by measuring sense of belonging and the role of social connectedness in relation to diabetes specific competence, diabetes distress and self-management to build an understanding of how individuals can be supported to successfully manage type 2 diabetes. Previous research (Williams et al., 1998; Williams et al., 2004; Williams et al., 2009) has focused on autonomy and competence as measures when applying the SDT to diabetes and not focused on the concept of relatedness, thus autonomy will not be specifically measured in the current study.

To date, there has been no research explicitly exploring the role of social connectedness in perceived competence, diabetes distress and self-management among individuals living with type 2 diabetes. Research questions were influenced by the SDT concept of relatedness to understand how a sense of belonging and connection may impact those living with type 2 diabetes. Although the current study will use social connectedness as an outcome measure to understand the sense of belonging rather than a measure of relatedness, the SDT concept of relatedness remains a relevant context to understand the role of social connectedness.

Exploring social connectedness within a SDT framework adds to existing SDT research in the context of diabetes since the majority of research in this field focuses on the concepts of autonomy and competence. Whilst the current study will measure and refer to sense of belonging as social connectedness, it is viewed from the lens of the SDT concept of relatedness, defined as the need to experience a sense of belonging or attachment to other people.

Social connection is important for maintaining wellbeing and research suggests that having social relationships is associated with the maintenance of good health including both physical and psychological health outcomes (Lee, Draper and Lee, 2001; Mauss et al, 2011; Ashida and Heaney, 2008). Moreover, lacking social connection is associated with increased likelihood of being diagnosed with type 2 diabetes (Brinkues et al, 2017). Thus, it is predicted that for individuals managing the multiple behavioural demands of type 2 diabetes, having a strong sense of social connection will support self-management behaviours and increase one's belief in their ability to manage their diabetes. There is a consistent body of research to suggest individuals experiencing diabetes distress are more likely to struggle with managing type 2 diabetes (Peyrot et al, 2005; Fisher et al, 2010; Tareen and Tareen, 2017). It

is also widely accepted that social support plays an important role in supporting self-management and decreasing distress levels (Wiebe et al, 2016; Aikens et al, 2015; Schiøtz et al, 2012; Young et al, 2020). Considering these findings, it is predicted that higher levels of perceived social connectedness will be associated with lower levels of diabetes distress among individuals living with type 2 diabetes. Understanding the role of social connectedness in type 2 diabetes will provide important information to guide interventions and support individuals identified as being socially disconnected.

Guided by the SDT and the concept of relatedness, this study will use the measure of social connectedness, defined as “a subjective psychological bond that people feel in relation to individuals and groups of others” (Haslam et al., 2015) to understand how a sense of belonging and connection may influence psychological and physical outcomes among individuals living with type 2 diabetes, and the role of social connectedness in the context of the COVID-19 pandemic. The overall aim of the present study was therefore to understand whether perceived social connectedness has a role in predicting diabetes related distress, perceived competence and diabetes self-management behaviours among adults living with type 2 diabetes in the UK. It was hypothesised that social connectedness will be associated with increased perceived competence and self-management behaviour. Furthermore, it was hypothesised that higher levels of social connectedness among individuals living with type 2 diabetes will be associated with lower levels of diabetes distress.

Rationale for Measures

Social connectedness is measured using the social connectedness scale (SCS-R) developed by Lee and Robbins (1995). As previously mentioned, social connectedness is used as an outcome measure for a sense of belonging, influenced by the concept of relatedness proposed

by the SDT. The SCS-R was felt to be the best measure for sense of belonging given no specific scale to measure the concept of relatedness alone. To measure diabetes self-management, the diabetes self-management questionnaire (DSMQ) was felt to be the best measure to capture a variety of self-management behaviours including contact with healthcare professionals compared to other measures of diabetes self-management such as the summary of diabetes self-care activities measure (Toobert et al, 2000). Perceived competence is measured using the perceived competence in diabetes scale (PCDS) (Williams et al, 2004) due to a specific focus on diabetes related competence rather than a more general measure of competence. The diabetes distress scale (DDS) developed by Polonsky et al (2005) was chosen to measure diabetes related distress in the current study. Whilst other measures were considered as a measure of diabetes distress, the DDS was felt to be more reflective of problems concerning diabetes self-management as a whole and therefore the best fit for the current study. The above measures will be discussed further in the Methods section.

Research questions

- 1) How does perceived social connectedness influence self-management behaviour among individuals living with type 2 diabetes during a pandemic?
- 2) How does perceived social connectedness influence diabetes distress among individuals living with type 2 diabetes during a pandemic?
- 3) How does perceived social connectedness influence perceived competence among individuals living with type 2 diabetes during a pandemic?

Hypotheses

It was hypothesised that after controlling for effects of confounding variables:

1. Higher levels of perceived social connectedness will predict more effective self-management behaviour among individuals living with type 2 diabetes.
2. Higher levels of perceived social connectedness will predict increased perceived competence in diabetes management among individuals living with type 2 diabetes.
3. Higher levels of perceived social connectedness will predict lower levels of diabetes distress among individuals with type 2 diabetes.

Methods

Design

The research utilised a cross-sectional quantitative design to measure the relationship between the predictor variable (social connectedness) and outcome variables (perceived competence, diabetes distress and self-management) among individuals living with type 2 diabetes. A quantitative approach was chosen due to the ability to collect large scale quantitative data to identify causal variables or correlational relationships (Muijs, 2010). Four outcome measures were used in this study to measure the chosen variables; diabetes distress, diabetes management, perceived competence in diabetes and perceived social connectedness (Appendices F-I). A demographic questionnaire was also administered to collect data on age, gender, ethnicity, diabetes duration, and diabetes treatment (Appendix E). Where possible, shorter questionnaires were chosen to support completion rates as research suggests the length of online surveys has a negative relationship with completion rates (Fan and Yan, 2010).

The survey was administered online via an online survey platform, Qualtrics (www.qualtrics.com). Online methods were chosen due to the design and to allow data collection to commence during government lockdown throughout the coronavirus (COVID-19) pandemic, ensuring the safety of participants and researchers whilst adhering to university and government guidelines.

Survey testing and patient involvement

Previous and current professional roles of the lead researcher involve working with individuals living with diabetes and healthcare professionals working in diabetes care. Prior to ethics submission, documents to be used as part of the research were presented to

healthcare professionals working in a diabetes setting for general feedback on appropriateness and language. No issues or concerns were raised, and the questionnaires and forms were submitted for ethical approval.

Conducting survey testing with a small number of participants can improve online questionnaire reliability (Dilman, Smyth and Christian, 2014) and ensure survey questions and instructions are clear to potential participants before publishing. Once ethical approval was granted and the survey design was complete, a test link to the study questionnaires was sent to five individuals living with type 2 diabetes who had previously consented to be contacted for future research and evaluation after accessing NHS services. An email (Appendix M) was sent containing a link to a test survey and individuals were asked to respond to the following questions and provide further feedback:

- Were the instructions and questions easy to understand?
- Do you feel the questions are appropriate for the purpose of the study?
- Was there anything we didn't ask that you feel we should have?

Four participants responded (Appendix M) and some minor changes were made following feedback from pre-testing including making exclusion criteria clearer for participants and adding a progress bar to the survey.

Recruitment and sample

G*Power 3.1 (Faul et al., 2007) was used to conduct a power analysis based on a medium effect size ($f^2 = 0.15$). Analysis showed that to obtain 0.95 power and detect a similar effect

size at the 0.05 alpha, a total of 89 participants would be required. Whilst a power level of .80 is usually considered sufficient, the G*Power default level of power of .95 was maintained to provide a more stringent analysis.

Recruitment of participants took place between December 2020 and May 2021 using opportunity sampling. An online questionnaire was published on Qualtrics which participants could access using an anonymous link. Participants were recruited via social networking sites (i.e., Twitter, Facebook), online forums (e.g., Diabetes UK), online community newsletters and university participant pool.

Participants were eligible for the study if they were: UK based adults aged 18 years or over with a diagnosis of type 2 diabetes. Participants were excluded if: they had a diagnosis of other types of diabetes (e.g., type 1 diabetes, gestational diabetes) due to differences in management requirements, if they were unable to read and write English, and if they had a severe medical co-morbidity.

A total of 191 potential participants accessed the online survey. After exclusion due to not consenting to take part in the research, incomplete responses where participants did not complete all questions and participant withdrawal, a total of 142 participant responses were included for analysis (Appendix K), thus the final sample size was larger than the 89 participants required to obtain 0.95 power as described above. The average response time for participants was 13 minutes. `

Measures

Demographic Questionnaire

Participants were asked seven demographic questions to collect information on participants' gender, age, marital status and ethnicity. This sociodemographic data was collected by asking participants to select the category that best describes them from a drop-down list of options. Participants were also asked three questions related to their diabetes including years since diagnosis of type 2 diabetes, their current HbA1c level and medication taken to manage their diabetes. Participants were asked to select one of four categories for medication type (tablets, insulin, both or none) and were provided with a free text box to input an answer for duration of diagnosis in years and HbA1c in the format of a percentage or mmol/mol. HbA1c responses provided in the format of a percentage were converted to mmol/mol prior to analysis.

Social Connectedness Scale - Revised (SCS-R)

The SCS-R was used to measure social connectedness. The questionnaire was developed by Lee and Robbins (1995) and includes twenty items assessing the degree to which individuals feel connected. Items are rated on a six-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). The SCS-R comprises 10 positive and 10 negative questions, asking participants about their sense of belonging in relation to their interpersonal relationships, their social world and difficulties establishing and maintaining a sense of closeness. Example items include 'I feel close to people' and 'I don't feel I participate with anyone or any group'. Items are summed to provide a total score, with negatively worded items reverse scored to create a scale score with a possible range from 20-120. High scores reflect a stronger sense of social connectedness. The SCS-R is reported to have high reliability (internal consistency $\alpha > .92$) and good convergent and discriminant validity.

Diabetes Self-Management Questionnaire (DSMQ)

The DSMQ is a 16-item questionnaire developed to assess self-care activities associated with glycaemic control in individuals living with diabetes. Items cover different aspects of diabetes self-management including diet, medication adherence, physical activity and interaction with healthcare professionals. Items are scored on a 4-point likert scale from 0 (does not apply to me) to 3 (applies to me very much) and participants are asked to answer statements such as ‘I keep all doctors’ appointments recommended for my diabetes treatment’ and ‘I do regular physical activity to achieve optimal blood sugar levels’ in relation to their diabetes self-care over the past eight weeks. Scoring of the DSMQ involves summing scores of all items after reversing the scores of nine negatively worded statements with higher scores representing more effective self-care. The DSMQ is reported to have good internal consistency ($\alpha > .84$) for use in type 2 diabetes and good validity when tested for factorial and convergent validity (Schmitt, Gahr, Hermanns, Kulzer, Huber and Haak, 2013).

Perceived Competence in Diabetes Scale (PCDS)

Participants’ perceived competence in management of their diabetes was measured using the PCDS, a 4-item measure assessing the degree to which individuals feel able to manage daily aspects of diabetes care. Items are rated on a 7-point Likert scale ranging from 1 (not at all true) to 7 (very true) and ask participants to rate items to reflect how they are able to deal with their diabetes e.g., ‘I feel able to meet the challenge of controlling my diabetes’. Scoring of the PCDS involves summing scores of all items, with higher scores representing greater perceived competence in managing diabetes (Williams et al, 2004; 2005). The PCDS has been found to have good internal consistencies with a Cronbach’s alpha between 0.83 and 0.9 and has been previously used to examine a SDT model for diabetes management (Williams et al 2004).

Diabetes Distress Scale (DDS17)

The DDS17 is a seventeen-item scale assessing diabetes-related emotional distress.

Participants are asked to consider the degree to which each item has bothered them during the past month and rate items on a 6-point Likert scale from 1 (not a problem) to 6 (a very serious problem). Items relate to emotional burden (five items) e.g., ‘Feeling overwhelmed by the demands of living with diabetes’, physician related distress (four items) e.g., ‘feeling that my doctor doesn’t take my concerns seriously enough’, regimen related distress (five items) e.g., ‘feeling that I am not testing my blood sugars frequently enough’ and interpersonal distress (three items) e.g., ‘Feeling that friends or family are not supportive enough of self-care efforts’. The DDS17 yields a total score and four sub-scale scores, each addressing a different kind of distress with higher scores indicating greater distress levels. The DDS17 is found to have good internal reliability ($\alpha > .93$) and validity (Polonsky et al, 2005).

Coronavirus (COVID-19)

Due to data collection taking place throughout the COVID-19 pandemic within a national lockdown, three questions were included to gather descriptive information on how participants perceive COVID-19 to have impacted their diabetes management and social connectedness. Participants were first asked to confirm whether they had received a shielding letter as a result of COVID-19 pandemic asking them not to leave home for any reason due to increased risk. Participants were provided with a free text box to write their response to the following questions:

- How do you feel the coronavirus (COVID-19) pandemic has affected your diabetes management? Please use examples where possible.

- How do you feel the coronavirus (COVID-19) pandemic has affected your social connectedness (sense of belonging)? Please use examples where possible.

Ethical considerations

Ethical approval was granted by the Research Ethics committee at the University of the West of England (Appendix A). Furthermore, the code of human research ethics (British Psychological Society (BPS), 2021) and the BPS (2021) ethics guidelines for internet-mediated research were followed to ensure potential ethical issues were considered in the design and implementation of this study. No deception or covert data collection took place as part of this study.

Consent

Participants were required to freely and voluntarily consent to participate and were given sufficient information to enable them to make an informed choice on whether to participate. Study advertisements posted online gave a brief outline of the research explaining that full details were available in the link provided to access the study. Individuals who accessed the study link were provided with full study details including the purpose of the research and what participation would involve (Appendix B). The benefits of taking part in the study were explained to be contributing to the research area and building a better understanding of how social connectedness may influence the management of type 2 diabetes and how individuals experience their diabetes. Participants were made aware that once complete, the final research report would be made available on the University of the West of England's open-access research repository and that a copy could be made available to them if they requested. It was also stated that the research may also be submitted for publication in an academic journal upon completion.

A consent form (Appendix C) was displayed to participants following the detailed study information to ensure transparency and participants were encouraged to download and keep a copy of both the participant information sheet and consent form. Questionnaires were only displayed to participants once they had provided consent to take part and confirmed they met eligibility criteria. If a participant did not consent or in the instance where exclusion criteria applied, the questionnaires were not displayed and they were taken to the end of the study page.

Withdrawal

Within the information sheet displayed to participants prior to consenting to take part in the research, it was explained that participation was entirely voluntary and that they were able to withdraw their consent by contacting the research team and providing the anonymous participant number they created. Due to timescales of the data collection and write up, participants were able to withdraw from the study up to one month after the date of which they completed the study which was made clear in the information sheet provided.

Withdrawal information was also provided in the debrief sheet displayed at the end of the survey (Appendix D).

Risk

Risk is defined as the ‘potential physical or psychological harm, discomfort or stress to human participants’ as a result of research’ (BPS, 2021). A risk assessment was carried out and submitted to the Research Ethics Committee within the ethics application. Negligible risks were anticipated including possible distress as a result of potentially sensitive topics such as diabetes distress and social connectedness, and potential loss of data. Control measures were put in place and no further action was necessary. It was made clear to

participants that they were able to stop completing the questionnaires at any time if they felt uncomfortable.

Confidentiality

Careful consideration was taken to ensure personal data was kept confidential and secure.

Qualtrics was used to distribute the questionnaire and manage data securely online.

Participants accessed the study using an anonymous link to ensure participant confidentiality and anonymity and no identifiable information was collected from participants. To ensure data could be located in the event of an individual requesting to withdraw their data from the study, participants were asked to create and write down an anonymous code.

Debriefing

Participants were provided with a debrief sheet (Appendix D) following completion of the questionnaire and asked to download a copy for their own reference and in case of the wish to withdraw at a later date.

Procedure

Participants were recruited through opportunity sampling using online methods advertising the study online with a brief summary of the research and expected time to complete. An anonymous link (via Qualtrics) was included in advertisements of the study enabling participants to access from their own device at a time convenient for them. Accessing the web link displayed participants with the participant information sheet (Appendix B) followed by inclusion and exclusion criteria to ensure participants were eligible before the consent form was displayed. If participants confirmed they were eligible and provided consent to take part in the study, they were asked to create an anonymous code to maintain confidentiality

and enable researchers to identify their data should they wish to withdraw from the study at a later date.

Demographic data were collected from participants followed by the outcome questionnaires SCS-R, DSMQ, PCDS and DDS (Appendix E-I). Participants were then displayed with three questions related to the COVID-19 pandemic (Appendix J). If participants did not complete all questions for a given measure a prompt was displayed to prompt participants with two options; 'continue without answering' or 'answer the questions'. At the end of the survey, participants were presented with the debrief sheet containing withdrawal information and researcher contact details.

Data analysis

Data were analysed using SPSS version 27.0.1.0 (IBM Corp, 2020). Continuous variables HbA1c and duration of diagnosis were converted to categorical variables for the purposes of descriptive statistics however were analysed as continuous variables in the regression analysis. Multiple hierarchical regressions were conducted to analyse research questions. Assumptions outlined by Berry (1993) were tested and dummy variables were created for categorical variables with more than two categories as recommended by Hardy (1993). Control variables (general and diabetes-specific demographic variables) were entered into the model in step 1, followed by the predictor variable social connectedness in step 2 of each hierarchical regression model which was regressed on the dependent variable. Data analyses were pre-registered and are available on Open Science Framework (OSF). The data analysis plan and raw dataset are available on OSF at <https://osf.io/2jx78>.

Results

Sample characteristics

142 participants were included in analysis following exclusion (Appendix K).

Sociodemographic information for the sample is included in Table 1. The majority of the sample identified themselves to be female (62%) and White British (87%). The largest proportion of participants were between the ages of 56 and 65 (26.8%) and married (47%). The duration of diagnosis of type 2 diabetes ($N = 139$) ranged from 2 months to 28 years ($M = 7.61$; $SD = 5.57$). HbA1c levels reported ($N = 66$) ranged from 28-108 mmol/mol ($M = 56.29$; $SD = 18.00$) with over half of participants ($N = 42$) providing a HbA1c above the recommended level of 48 mmol/mol. The majority of participants ($N = 87$, 61%) reported to manage their diabetes by taking tablets.

Table 1

Demographic description of participants

Variable	N	%
Age		
18-25	3	2.1
26-35	19	13.4
36-45	23	16.2
46-55	37	26.1
56-65	38	26.8
66-75	19	13.4
76+	3	2.1
Gender		
Male	54	38.0
Female	88	62.0
Ethnicity		
White British	123	86.6
White Other	4	2.8
Asian	3	2.1

Variable	N	%
Asian British	3	2.1
Black	1	0.7
Black British	3	2.1
Mixed	4	2.8
Other ethnic group	1	0.7
Marital status		
Single (never married)	31	21.8
Married	67	47.2
Living with partner	17	12.0
Divorced/separated	22	15.5
Widowed	5	3.5

Note. N=142

Reliability analysis

To investigate and identify any reliability issues, a reliability analysis was carried out by calculating internal consistency coefficients (Cronbach's alpha) for all outcome measures; SCS-R, DDS-17, PCDS and DSMQ. A reliability analysis indicated that all measures had good internal consistency with a Chronbach's alpha of $> .70$. Individual Cronbach's alpha for each measure are displayed in Table 2.

Table 2

Reliability analysis

Measure	Items	Chronbach's Alpha
SCS-R	20	.96
DSMQ	16	.86
PCDS	4	.95
DDS	17	.93

Note. SCS-R = Social Connectedness Scale Revised; DSMQ = Diabetes Self-Management Scale; PCDS = Perceived Competence in Diabetes Scale; DDS = Diabetes Distress Scale

Descriptive statistics

SCS-R

Scores ranged from 30-114 with a mean score of 77.30 (SD = 20.31). The overall mean score of the sample was lower than mean scores reported in previous research (Lee et al, 2001; Capanna et al, 2013). Full descriptive statistics reporting mean social connectedness scores across demographic variables are shown in table 3 with higher scores reflecting a stronger sense of social connectedness.

Table 3

Means and standard deviation for Social Connectedness Scale Revised (SCS-R)

Variable	N	M	SD
Gender			
Male	54	74.30	21.58
Female	88	79.15	19.38
Age			
18-25	3	54.33	12.67
26-35	19	65.84	18.44
36-45	23	75.87	17.19
46-55	37	78.46	17.88
56-65	38	81.37	21.59
66-75	19	83.37	23.68
76+	3	81.33	20.60
Ethnicity			
White British	123	77.27	21.21
White Other	4	73.25	11.03
Asian	3	77.33	7.51
Asian British	3	93.67	8.50
Black	1	64.00	-
Black British	3	68.67	3.79
Mixed	4	75.75	19.00
Other ethnic group	1	94.00	-
Marital status			
Single (never married)	31	64.48	18.62
Married	67	84.73	19.14
Living with partner	17	72.47	20.63
Divorced/separated	22	75.91	17.45

Variable	N	M	SD
Widowed	5	79.80	16.62
Medication			
None	31	74.97	22.71
Tablets	87	78.29	19.70
Insulin	7	71.71	21.53
Tablets and Insulin	17	78.82	19.39
HbA1c			
Not Stated	76	74.40	19.53
<48 mmol/mol	24	82.42	20.65
>48 mmol/mol	42	79.64	21.09
Duration of diagnosis (years)			
Not Stated	3	72.33	7.77
<5	46	78.52	19.34
5-10	48	76.46	19.99
10-20	39	77.97	21.79
>20	6	72.83	28.51
Shielding			
Yes	48	75.38	21.41
No	85	78.09	19.73
Not Stated	9	80.11	21.25
Total	142	77.30	20.31

Note. M = Mean. SD = Standard Deviation

DSMQ

Scores ranged from 16 to 56 with a mean score of 34.67 (SD = 8.13). Full descriptive statistics reporting mean scores for demographic variables are shown in table 4 with higher scores indicating more effective self-management.

Table 4

Means and standard deviation for Diabetes Self-Management Questionnaire (DSMQ)

Variable	N	M	SD
Gender			
Male	54	33.67	8.21
Female	88	35.30	8.06
Age			

Variable	N	M	SD
18-25	3	44.67	8.96
26-35	19	38.47	4.83
36-45	23	34.66	7.21
46-55	37	34.84	8.82
56-65	38	34.00	8.71
66-75	19	31.26	7.59
76+	3	28.67	2.52
Ethnicity			
White British	123	33.93	8.20
White Other	4	38.00	6.16
Asian	3	38.33	6.35
Asian British	3	37.67	2.08
Black	1	40.00	-
Black British	3	36.33	5.69
Mixed	4	44.40	7.59
Other ethnic group	1	43.00	-
Marital status			
Single (never married)	31	38.42	7.96
Married	67	33.40	7.83
Living with partner	17	34.76	7.15
Divorced/separated	22	33.18	7.92
Widowed	5	34.60	12.60
Medication			
None	31	36.13	9.27
Tablets	87	34.79	7.67
Insulin	7	36.29	11.61
Tablets and Insulin	17	30.71	5.66
HbA1c			
Not Stated	76	37.24	8.09
<48 mmol/mol	24	27.33	6.11
>48 mmol/mol	42	34.21	6.52
Duration of diagnosis (years)			
Not Stated	3	38.67	4.93
<5	46	34.22	6.98
5-10	48	36.79	8.87
10-20	39	32.82	8.60
>20	6	31.17	4.02
Shielding			
Yes	48	36.63	7.57

Variable	N	M	SD
No	85	34.20	8.10
Not Stated	9	28.67	8.53
Total	142	34.67	8.13

Note. M = Mean. SD = Standard Deviation

PCDS

Scores ranged from 1-7 with a mean score of 4.86 (SD = 1.47). Table 5 shows full descriptive statistics across demographic variables for PCDS scores with higher scores representing greater perceived competency in managing diabetes.

Table 5

Means and standard deviation for Perceived Competence in Diabetes Scale (PCDS)

Variable	N	M	SD
Gender			
Male	54	4.99	1.40
Female	88	4.79	1.51
Age			
18-25	3	4.83	1.01
26-35	19	4.39	1.48
36-45	23	4.78	1.17
46-55	37	4.81	1.43
56-65	38	4.73	1.61
66-75	19	5.59	1.49
76+	3	6.17	0.88
Ethnicity			
White British	123	4.98	1.44
White Other	4	3.25	1.65
Asian	3	5.08	1.01
Asian British	3	4.08	1.88
Black	1	4.25	-
Black British	3	5.25	0.66
Mixed	4	3.50	1.74
Other ethnic group	1	4.00	-
Marital status			
Single (never married)	31	4.45	1.29

Variable	N	M	SD
Married	67	5.15	1.51
Living with partner	17	4.38	1.44
Divorced/separated	22	5.08	1.47
Widowed	5	4.30	1.41
Medication			
None	31	5.09	1.63
Tablets	87	4.71	1.40
Insulin	7	4.61	1.78
Tablets and Insulin	17	5.32	1.36
HbA1c			
Not Stated	76	4.58	1.49
<48 mmol/mol	24	5.92	1.08
>48 mmol/mol	42	4.78	1.37
Duration of diagnosis (years)			
Not Stated	3	4.75	0.66
<5	46	4.84	1.56
5-10	48	4.61	1.33
10-20	39	5.00	1.56
>20	6	6.25	0.52
Shielding			
Yes	48	4.71	1.23
No	85	4.91	1.52
Not Stated	9	5.19	2.14
Total	142	4.86	1.47

Note. M = Mean. SD = Standard Deviation

DDS

Scores ranged from 1-6 with a mean score of 2.35 (SD = 0.96) indicating moderate distress.

Full descriptive statistics across demographic variables for diabetes distress levels are shown in table 6 with higher scores indicating greater distress levels.

Table 6

Means and standard deviation for Diabetes Distress Scale (DDS)

Variable	N	M	SD
Gender			
Male	54	2.20	0.97

	Variable	N	M	SD
Age	Female	88	2.44	0.95
	18-25	3	3.29	1.13
	26-35	19	3.42	1.16
	36-45	23	2.16	0.70
	46-55	37	2.21	0.67
	56-65	38	2.39	0.88
	66-75	19	1.74	0.76
	76+	3	1.18	0.26
Ethnicity	White British	123	2.27	0.91
	White Other	4	2.78	0.65
	Asian	3	2.08	0.39
	Asian British	3	2.35	1.27
	Black	1	3.82	-
	Black British	3	2.35	1.45
	Mixed	4	3.81	1.43
	Other ethnic group	1	3.41	-
Marital status	Single (never married)	31	2.55	1.12
	Married	67	2.20	0.93
	Living with partner	17	2.79	0.97
	Divorced/separated	22	2.08	0.71
	Widowed	5	2.69	0.76
Medication	None	31	2.34	0.96
	Tablets	87	2.31	0.87
	Insulin	7	3.24	1.28
	Tablets and Insulin	17	2.17	1.18
HbA1c	Not Stated	76	2.42	0.99
	<48 mmol/mol	24	2.00	0.82
	>48 mmol/mol	42	2.41	0.97
Duration of diagnosis (years)	Not Stated	3	3.29	0.98
	<5	46	2.31	0.88
	5-10	48	2.44	0.91
	10-20	39	2.32	1.12
	>20	6	1.63	0.43
Shielding	Yes	48	2.42	0.91
	No	85	2.30	1.01

Variable	N	M	SD
Not Stated	9	2.42	0.85
Total	142	2.35	0.96

Note. *M* = Mean. *SD* = Standard Deviation. <2.0 = little to no distress; $2.0-2.9$ = moderate distress; >3.0 = high distress

DDS Subscales

Mean scores across all DDS subscales (emotional, physician, regimen, interpersonal) were between 2 and 3 indicating moderate distress. Mean scores for each DDS subscale across all demographic variables are shown in table 7 and mean DDS scores for each subscale for individual demographic variables are displayed in table 8.

Table 7

DDS-17 Subscales

Measure	Items	Mean	SD
Emotional	5	2.49	1.15
Physician	4	2.11	1.26
Regimen	5	2.54	1.24
Interpersonal	3	2.09	1.15

Note. <2.0 = little to no distress; $2.0-2.9$ = moderate distress; >3.0 = high distress
SD = Standard Deviation

Table 8

Means and standard deviation for DDS subscales

Variable	Emotional		Physician		Regimen		Interpersonal	
	M	SD	M	SD	M	SD	M	SD
Age								
18-25	3.20	1.40	3.00	1.75	3.27	1.29	3.89	0.51
26-35	3.87	1.38	2.84	1.56	3.62	1.29	3.09	1.45
36-45	2.25	0.75	1.91	1.20	2.31	1.01	2.10	1.08
46-55	2.26	0.82	1.98	1.22	2.52	1.02	1.88	0.83
56-65	2.63	1.07	2.11	1.05	2.53	1.25	2.11	1.16
66-75	1.68	0.79	1.89	1.29	1.88	1.22	1.37	0.46
76+	1.27	0.46	1.00	0.00	1.33	0.42	1.00	0.00

Variable	Emotional		Physician		Regimen		Interpersonal	
	M	SD	M	SD	M	SD	M	SD
Gender								
Male	2.27	1.09	2.07	1.25	2.41	1.20	1.86	1.00
Female	2.63	1.17	2.13	1.28	2.62	1.26	2.23	1.22
Ethnicity								
White British	2.40	1.09	2.07	1.25	2.44	1.17	2.04	1.15
White Other	2.70	1.04	2.88	2.05	3.05	0.66	2.33	0.61
Asian	2.40	0.40	1.67	0.63	2.13	0.42	2.00	0.35
Asian British	3.20	2.25	1.17	0.29	2.73	1.45	1.89	0.69
Black	3.80	-	3.75	-	3.80	-	4.00	-
Black British	2.33	0.95	2.17	1.61	2.60	1.59	2.22	1.84
Mixed	4.25	1.81	2.94	1.21	4.70	2.08	2.75	1.50
Other	3.40	-	3.25	-	3.40	-	3.67	-
Marital status								
Single	2.83	1.39	1.93	1.00	2.85	1.37	2.42	1.29
Married	2.30	1.06	2.12	1.31	2.39	1.17	1.86	1.05
Living with partner	3.01	1.30	2.47	1.28	2.81	1.18	2.78	1.22
Divorced/separated	2.17	0.79	1.80	1.29	2.30	1.10	1.92	1.05
Widowed	2.80	0.62	3.30	1.44	2.72	1.87	1.67	0.24
HbA1c								
Not Stated	2.47	1.15	2.14	1.28	2.79	1.38	2.14	1.28
<48 mmol/mol	2.21	0.94	2.06	1.50	1.73	0.82	2.00	1.04
>48 mmol/mol	2.71	1.27	2.08	1.13	2.54	0.96	2.10	1.12
Duration of diagnosis (years)								
Not Stated	3.13	0.64	2.92	0.95	3.67	1.45	3.44	1.26
<5	2.59	1.17	2.07	1.31	2.34	1.13	2.11	1.11
5-10	2.44	1.01	2.19	1.29	2.79	1.10	2.17	1.14
10-20	2.52	1.36	2.03	1.19	2.52	1.48	2.03	1.21
>20	1.73	0.35	1.88	1.52	1.63	0.54	1.11	0.17
Medication								
None	2.32	1.16	2.31	1.52	2.46	1.27	2.23	1.27
Tablets	2.48	1.05	2.03	1.14	2.53	1.13	2.06	1.11
Insulin	3.57	1.50	3.07	1.15	3.43	1.90	2.57	1.17
Tablets and Insulin	2.50	1.36	1.74	1.25	2.40	1.37	1.84	1.15
Shielding								
Yes	2.50	1.04	2.21	1.32	2.74	1.25	2.04	1.08
No	2.45	1.19	2.00	1.17	2.49	1.22	2.14	1.23
Not Stated	2.91	1.37	2.72	1.71	1.98	1.24	1.93	0.62

Note. M = Mean. SD = Standard Deviation

Regression analyses

Multiple hierarchical multiple regression analyses were used to assess the relationship between the predictor variables and outcome variables whilst controlling for confounding variables. To examine whether social connectedness predicts diabetes self-management, perceived competence and diabetes distress levels, other predictor variables including general and diabetes-specific demographic variables were entered at Step 1 in all analyses and social connectedness was entered at Step 2 in all analyses. Prior to conducting hierarchical multiple regressions, the relevant assumptions were tested and are explained below.

Social connectedness and diabetes self-management

A two-step hierarchical multiple regression was run to determine if the addition of social connectedness predicted diabetes self-management once other variables were controlled. See Table 9 for full regression results. There was linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values. There was independence of residuals, as assessed by a Durbin-Watson statistic of 2.21. There was homoscedasticity, as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values and there was no evidence of multicollinearity as assessed by tolerance values greater than 0.1. There were no studentized deleted residuals greater than +3 standard deviations. Some high leverage points were identified by checking for values greater than 0.2, however no influential cases were observed as values for Cook's distance were all below 1 therefore no cases were removed from the regression model. The assumption of normality was met, as assessed by histogram and P-P Plot.

Table 9*Hierarchical Regression: Diabetes Self-Management Questionnaire (DSMQ)*

Variable	Model 1				Model 2			
	<i>B</i>	β	<i>t</i>	<i>p</i>	<i>B</i>	β	<i>t</i>	<i>p</i>
(Constant)	28.40		5.70	<.001	39.92	5.41	7.38	<.001
Age								
18-25	6.30	.11	1.11	.27	3.77	.07	.71	.48
26-35	.34	.01	.14	.88	-1.53	-.06	-.66	.51
36-45	-1.94	-.09	-.88	.38	-2.48	-.11	-1.20	.23
56-65	-1.00	-.06	-.57	.57	-.62	-.03	-.37	.71
66-75	-2.78	-.12	1.22	.22	-1.76	-.07	-.82	.42
76+	-7.79	0.14	-1.66	.10	-6.75	-.12	-1.54	.13
Gender	.07	.00	.05	.96	1.15	.07	.86	.39
Ethnicity								
White Other	5.17	.11	1.29	.20	4.34	.09	1.16	.25
Asian	3.29	0.6	.74	.46	3.49	.06	.84	.40
Asian British	3.58	.06	.79	.43	6.66	.12	1.54	.13
Black	-4.16	-.04	-.42	.67	-3.49	-.04	-.38	.71
Black British	2.32	.04	.51	.61	2.53	.05	.60	.55
Mixed	9.11	.19	2.18	.03	10.21	.21	2.61	.01
Other	4.54	.05	.58	.57	6.34	.07	.86	.39
Marital status								
Single	3.53	.18	1.93	.06	1.05	.05	.58	.57
Living with partner	1.00	.04	.45	.65	-.02	-.00	-.01	.99
Divorced/separated	-.47	-.02	-.25	.81	-1.89	-.09	-1.05	.30
Widowed	2.44	.06	.67	.50	.89	.02	.26	.80
HbA1c	.16	.24	2.74	.01	.15	.22	2.71	.01
Duration of diagnosis	.08	.05	.55	.58	-.01	-.01	-.07	.94
Medication type								
None	2.95	.15	1.80	.07	2.06	.11	1.33	.19
Insulin	-1.34	-.04	-.39	.70	-.51	-.01	-.16	.88
Tablets and Insulin	-5.78	-.23	-2.56	.01	-4.73	-.19	-2.23	.03
Shielding status	-2.23	-.16	-1.88	.06	-2.22	-.16	-1.99	.05
SCS*					-.14	-.36	-4.20	<.001

Note. *N* = 142

* = Entered in Step 2

Excluded variables: age = 46-55, marital status = married, ethnicity = White British, medication = tablets

The full model of all predictor variables (gender, age, ethnicity, medication type, HbA1c, shielding status, duration of diagnosis and social connectedness) to predict diabetes self-management was statistically significant, $R^2 = .41$, $F(25,116) = 3.18$, $p < .001$, adjusted $R^2 = .28$. The addition of social connectedness to the prediction of diabetes self-management led to a statistically significant increase in R^2 of .09, $F(1,116) = 17.66$, $p < .001$. Contrary to the hypothesis, regression results indicate that an increase in social connectedness predicts a decrease in diabetes self-management, as shown in Table 9.

Social connectedness and perceived competence

A two-step hierarchical multiple regression was run to determine if the addition of social connectedness predicted perceived competence in diabetes once other variables were controlled. See Table 10 for full details on each regression model. There was linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values. There was independence of residuals, as assessed by a Durbin-Watson statistic of 2.16. There was homoscedasticity, as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values and no evidence of multicollinearity as assessed by tolerance values greater than 0.1. There were no studentized deleted residuals greater than +3 standard deviations. Some high leverage points were identified by checking for values greater than 0.2, however no influential cases were observed as values for Cook's distance were all below 1 therefore no cases were removed from the regression model. The assumption of normality was met, as assessed by histogram and P-P Plot. The full model of all predictor variables (gender, age, ethnicity, medication type, HbA1c, shielding status, duration of diagnosis and social connectedness) to predict perceived competence in diabetes was statistically significant, $R^2 = .37$, $F(25,116) = 2.68$, $p < .001$, adjusted $R^2 = .23$. The addition of social connectedness to the prediction of perceived competence led to a

statistically significant increase in R^2 of .09, $F(1,116) = 16.18$, $p < .001$. As hypothesised, regression results indicate that as social connectedness increases, perceived competence in diabetes will also increase.

Table 10

Hierarchical Regression: Perceived Competence in Diabetes Scale (PCDS)

Variable	Model 1				Model 2			
	<i>B</i>	β	<i>t</i>	<i>p</i>	<i>B</i>	β	<i>t</i>	<i>p</i>
(Constant)	6.49		7.00	<.001	4.43		4.39	<.001
Age								
18-25	1.26	.12	1.20	.23	1.71	.17	1.72	.47
26-35	.31	.07	.68	.50	.64	.15	1.48	.14
36-45	.25	.06	.60	.55	.34	.09	.89	.38
56-65	.01	<.001	.03	.98	-.06	-.02	-.19	.85
66-75	.55	.13	1.30	.20	.37	.09	.92	.36
76+	1.16	.11	1.34	.18	.98	.10	1.20	.24
Gender	.01	<.001	.05	.96	-.18	-.06	-.72	.47
Ethnicity								
White Other	-1.93	-.22	-2.59	.01	-1.78	-.20	-2.54	.01
Asian	.14	.01	.17	.87	.10	.01	.13	.89
Asian British	-.76	-.07	-.89	.37	-1.31	-.13	-1.62	.11
Black	-1.61	-.09	-.88	.38	-1.73	-.10	-1.01	.32
Black British	.06	.01	.07	.95	.02	.00	.02	.98
Mixed	-1.40	-.16	-1.80	.07	-1.59	-.18	-2.18	.03
Other	-.13	-.01	-.09	.93	-.46	-.03	-.33	.74
Marital status								
Single	-.58	-.17	-1.72	.09	-.14	-.04	-.42	.68
Living with partner	-.79	-.18	-1.92	.06	-.61	-.14	-1.57	.12
Divorced/separated	.15	.04	.43	.67	.41	.10	1.20	.23
Widowed	-1.26	-.16	-1.87	.06	-.98	-.12	-1.54	.13
HbA1c	-.03	-.27	-3.03	.00	-.03	-.26	-3.01	<.001
Duration of diagnosis	.02	.06	.62	.54	.03	.11	1.27	.21
Medication type								
None	.16	.05	.53	.60	.32	.09	1.11	.27
Insulin	.39	.06	.61	.55	.24	.04	.40	.69
Tablets and Insulin	.76	.17	1.82	.07	.57	.13	1.45	.15

Variable	Model 1				Model 2			
	<i>B</i>	β	<i>t</i>	<i>p</i>	<i>B</i>	β	<i>t</i>	<i>p</i>
Shielding	.05	.02	.23	.82	.05	.02	.23	.82
SCS*					.03	.35	4.02	<.001

Note. *N* = 142

* = Entered in Step 2

Excluded variables: age = 46-55, marital status = married, ethnicity = White British, medication = tablets

Social connectedness and diabetes distress

A two-step hierarchical multiple regression was run to determine if the addition of social connectedness predicted diabetes distress once other variables were controlled. See Table 11 for full details on each regression model. There was linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values. There was independence of residuals, as assessed by a Durbin-Watson statistic of 2.16. There was homoscedasticity, as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values and no evidence of multicollinearity as assessed by tolerance values greater than 0.1. There were no studentized deleted residuals greater than +3 standard deviations. Some high leverage points were identified by checking for values greater than 0.2, however no influential cases were observed as values for Cook's distance were all below 1 therefore no cases were removed from the regression model. The assumption of normality was met, as assessed by histogram and P-P Plot.

The full model of all predictor variables (gender, age, ethnicity, medication type, HbA1c, shielding status, duration of diagnosis and social connectedness) to predict diabetes distress was statistically significant, $R^2 = .46$, $F(25,116) = 4.01$, $p < .001$, adjusted $R^2 = .35$. The

addition of social connectedness to the prediction of diabetes distress led to a statistically significant increase in R^2 of .04, $F(1,116) = 8.29$, $p = .005$. As hypothesised, regression results indicate that as social connectedness increases, diabetes distress decreases.

Table 11

Hierarchical Regression: Diabetes Distress Scale (DDS)

Variable	Model 1				Model 2			
	<i>B</i>	β	<i>t</i>	<i>p</i>	<i>B</i>	β	<i>t</i>	<i>p</i>
(Constant)	.68		1.25	.22	1.56		2.57	.01
Age								
18-25	.63	.09	1.02	.31	.43	.07	.72	.47
26-35	1.06	.38	4.02	<.001	.92	.33	3.52	<.001
36-45	.05	.02	.21	.84	.01	.00	.04	.97
56-65	.15	.07	.76	.45	.17	.09	.94	.35
66-75	-.50	-.18	-2.03	.04	-.42	-.15	-1.76	.08
76+	-1.18	-.18	-2.32	.02	-1.10	-.17	-2.23	.03
Gender	.02	.01	.10	.92				
Ethnicity								
White Other	.23	.04	.54	.59	.17	.03	.40	.69
Asian	-.46	-.07	-.96	.34	-.45	-.07	-.96	.34
Asian British	-.24	-.04	-.48	.63	-.00	.00	-.00	1.00
Black	.99	.09	.93	.35	1.05	.09	1.01	.32
Black British	.00	.00	-.00	1.00	.02	.00	.03	.97
Mixed	1.03	.18	2.27	.03	1.11	.19	2.52	.01
Other	.74	.07	.87	.39	.88	.08	1.06	.29
Marital status								
Single	-.15	-.06	-.75	.46	-.34	-.15	-1.67	.10
Living with partner	.28	.10	1.17	.25	.20	.07	.86	.39
Divorced/separated	-.08	-.03	-.36	.72	-.19	-.07	-.91	.37
Widowed	.85	.16	2.16	.03	.73	.14	1.90	.06
HbA1c	.02	.25	3.06	<.001	.02	.24	3.01	<.001
Duration of diagnosis	.02	.11	1.28	.20	.01	.07	.85	.40
Medication type								
None	.25	.11	1.39	.17	.18	.08	1.03	.31
Insulin	.33	.07	.87	.39	.39	.09	1.08	.28

Variable	Model 1				Model 2			
	<i>B</i>	β	<i>t</i>	<i>p</i>	<i>B</i>	β	<i>t</i>	<i>p</i>
Tablets and Insulin	-.42	-.14	-1.70	.09	-.34	-.11	-1.40	.16
Shielding	.13	.08	1.03	.31	.13	.08	1.07	.29
SCS*					-.01	-.23	-2.88	.01

Note. *N* = 142

* = Entered in Step 2

Excluded variables: age = 46-55, marital status = married, ethnicity = White British, medication = tablets

COVID-19

Participants were asked how COVID-19 had impacted their diabetes management and social connectedness. Responses were provided using a free text box.

COVID-19 and diabetes self-management

With regards to the impact on diabetes management, participant responses indicate COVID-19 had a negative impact on contact with healthcare team, mental health and self-management activities. Responses indicate that the COVID-19 pandemic had a substantial impact on healthcare appointments and access to healthcare services. In particular, participants described how appointments and routine diabetes health checks were cancelled. Participant responses also provide an insight into how COVID-19 has had an impact on their mental health, describing an increase in stress and worry. Furthermore, responses describe how COVID-19 has impacted usual self-management activities, particularly in relation to exercise and dietary habits. Some participants described how COVID-19 had positively influenced their diabetes self-management in relation to eating habits and exercise, and some responses described how COVID-19 has not had any impact on their diabetes management. Examples of participant responses relating to the impact of COVID-19 on diabetes management are shown in table 12, and all participant responses are shown in Appendix L.

COVID-19 and social connectedness

Participants were asked about how they feel COVID-19 has impacted their social connectedness. Many participant responses indicated a negative impact on social connectedness, describing feelings of isolation with minimal interactions as a result of COVID-19. Some participants, however, suggested that COVID-19 had positively impacted their social connectedness and sense of belonging. Responses suggest that for some, COVID-19 had little to no impact on their social connectedness with reference to the use of internet and telephone to maintain connection. Examples of participant responses relating to the impact of COVID-19 on social connectedness are shown in table 12, and all participant responses are shown in Appendix L.

Table 12*Participant responses describing impact of COVID-19*

Impact on diabetes self-management	Impact on social connectedness
“Worsened it as all appointments and routine checks have been cancelled”	“Don’t feel a sense of belonging to anything”
“My life has been work and home with little else in between. I have become quite lazy in my control”	“I feel increasingly isolated and have only had a few social interactions over 12 months”
“It has made it better, I meal plan for two to three weeks at a time now and am less inclined to buy and eat less healthy food as I do not go to the shops much”	“I feel somewhat isolated but I have especially felt disconnected to work. Shielding while others were going to work made me feel very separate”
“It’s been less under control due to stress”	“Very isolated. At home so much and now everyone can go out im still wary”
“It reminded me that I am more vulnerable”	“I’ve got isolated somehow from the society”
“I have been quite low at times which leads to comfort eating the wrong foods”	“Hugely - I dont socialise as much as I used to, even with restrictions lifting”
“I don’t feel as able to have routine diabetes management”	“Have isolated myself from everyone other than a couple of my closest friends”

Impact on diabetes self-management	Impact on social connectedness
“Lack of exercise in gym and pool”	“I feel it has got better because I make more effort to contact people by other means”
“It has made it easier to avoid Drs appointments”	“Not at all. If anything it has built a bigger sense of community in my social world through online means”
“I have been made more aware of needing to take care of myself since receiving a shielding letter”	“I see people in person less but I still stay connected via telephone and zoom etc”
“I don’t feel it has changed how I manage my diabetes at all”	“Not at all. There have been plenty of interactions using the internet”

Post-hoc mediation analysis

To investigate whether the relationship between social connectedness on diabetes self-management can be explained by perceived competence, a simple mediation analysis was performed using JASP (JASP Team, 2021). The outcome variable for the analysis was diabetes self-management. The predictor variable for the analysis was social connectedness and the mediator variable evaluated for the analysis was perceived competence.

The direct effect between social connectedness as the predictor variable and diabetes self-management as the outcome variable was found to be negative ($-.09$, $SE = .03$, $p = <.001$, 95% CI $[-.15, -.04]$). The relationship between social connectedness and diabetes self-management remained negative when perceived competence was added as a mediator ($-.07$, $SE = .02$, $p = <.001$, 95% CI $[-.10, -.03]$). The total effect after controlling for the mediator variable was significant ($-.16$, $SE = .03$, $p = <.001$, 95% CI $[-.22, -.10]$). Full results from the mediation analysis are shown in in Table 13.

Table 13*Post-hoc mediation analysis*

	Estimate	Std Error	z-value	p	95% Confidence Interval	
					Lower	Upper
Direct effects	-.09	.03	-3.41	<.001	-.15	-.04
Indirect effects	-.07	.02	-3.60	<.001	-.10	-.03
Total effects	-.16	.03	-5.24	<.001	-.22	-.10

Note. Delta method standard errors, normal theory confidence intervals, maximum likelihood (ML) estimator

Discussion

Summary of findings

The aim of the current study was to understand the role of perceived social connectedness in diabetes related distress, perceived competence and diabetes self-management among adults living with type 2 diabetes in the UK. The main findings of the current study were:

1. Perceived social connectedness predicts diabetes self-management, perceived competence in diabetes and diabetes distress levels among individuals living with type 2 diabetes during a pandemic.
2. An increase in perceived social connectedness predicts a decrease in diabetes self-management among adults living with type 2 diabetes.
3. An increase in perceived social connectedness predicts an increase in perceived competence in diabetes among adults living with type 2 diabetes.

4. An increase in perceived social connectedness predicts a decrease in levels of diabetes related distress among adults living with type 2 diabetes.

According to SDT (Deci and Ryan, 1985) the need to experience a sense of belonging to others (relatedness) is a basic psychological need and one that supports motivation and self-determination in health. Results from this study support the role of relatedness and sense of belonging in diabetes and will be discussed further in view of the role of social connectedness in relation to outcome measures.

Research question 1: Perceived social connectedness and diabetes self-management

The first aim of the current study was to understand if perceived social connectedness could predict diabetes self-management. Results from hierarchical multiple regression found that social connectedness was a significant predictor of diabetes self-management among individuals living with type 2 diabetes once other variables were controlled for.

Unexpectedly, regression results indicate that as social connectedness increases, diabetes self-management decreases.

Previous research has supported a link between SDT constructs of autonomy and competence and diabetes self-management, indicating that supportive autonomy and competence improve self-management and glycaemic control (Williams et al, 2005; Williams et al 2007; Williams et al 2009; Karlsen et al, 2018; Grønnegaard et al, 2020). To date, research has not explored the link between the concept of relatedness and diabetes-self management or glycaemic control thus the current findings may suggest that autonomy and competence are more significant in supporting diabetes self-management than relatedness. Research has, however,

suggested that self-management of type 2 diabetes is most effective when it occurs in the context of close and supportive relationships (DiMatteo, 2004; Shao et al, 2017; Lee et al, 2019). Whilst social connectedness is not synonymous to social support, results from this study indicate that higher levels of social connectedness thus indicating an increased sense of belonging to others is in fact associated with a decrease in diabetes self-management levels, contradicting previous findings on the role of support in the management of type 2 diabetes. Differences in findings may be explained by the distinction between social connectedness and social support as those who experience close relationships and have access to support such as living with another person, being married (DiMatteo, 2004), or having autonomy support from health supporters (Lee et al, 2019) does not necessarily mean that a person experiences a sense of belonging and connectedness.

Whilst the differences between social connectedness and social support may explain the difference in findings between current and previous findings, other research has found that in some cases social support had a negative impact on self-care and health outcomes in type 2 diabetes (van Dam et al, 2015). A negative relationship between social support and self-management was also reported in an earlier study by Miller and DiMatteo (2013). These findings are more consistent with those of the current study with increased social connectedness predicting a decrease in diabetes self-management, suggesting those with an increased sense of belonging have lower levels of self-care across different aspects including diet, medication adherence, physical activity and interaction with healthcare professionals. Miller and DiMatteo (2013) discuss feelings of criticism and guilt as possible explanations for the negative impact of social support on self-management, as well as competing demands between individuals and their family members acting as barriers to self-management. Although this research was exploring social support rather than social connectedness, it is

possible that maintaining social connectedness and sense of belonging may act as a barrier to engaging in diabetes self-management activities. The idea that maintaining a sense of connectedness and belonging may negatively impact those who are trying to juggle multiple roles whilst living with illness is consistent with earlier findings in older adults (Gallant, Spitze and Prohaska, 2007).

Regression results also suggest a significant decrease in diabetes self-management among those managing their diabetes with both tablets and insulin compared to participants managing their diabetes without medication or with insulin alone, suggesting that the additional demands required to manage the condition as a result of requiring multiple medications make it difficult to effectively self-manage diabetes. Results also indicated that mixed ethnicity significantly predicted diabetes self-management suggesting management varies across ethnicities, consistent with previous research (Johnson et al, 2014; Vaccaro et al, 2015).

HbA1c level provides a clinical measure of the management of type 2 diabetes and can be a useful indicator of effective self-management. Regression results indicate that an increase in HbA1c level is significantly associated with diabetes management, suggesting that those with higher glycaemic levels may be more aware of the need to manage their diabetes thus are more engaged in diabetes self-management. This is supported by previous research reporting that those with awareness of their HbA1 values reported better self-care and understanding of their glycaemic control compared to those that did not (Heisler et al, 2005).

Considering the impact of COVID-19 on diabetes self-management, regression results indicate that shielding status is significantly associated with a decrease in diabetes self-

management, which fits with recent research on the impact of COVID-19 reporting worse outcomes among those living with diabetes (Hartmann-Boyce et al, 2020).

Research question 2: Perceived social connectedness and competence in diabetes

The second aim of the current study was to understand if perceived social connectedness predicted perceived competence in diabetes. Hierarchical multiple regression results found that social connectedness does significantly predict perceived competence in diabetes among individuals living with type 2 diabetes once other variables are controlled for. Furthermore, results show that an increase in social connectedness predicts an increase in perceived competence in diabetes.

The importance of competence is highlighted in previous research and has been associated with an improvement in both physical and psychological outcomes including depressive symptoms, glycaemic control, and quality of life (Williams et al, 2004; Williams et al, 2005). Lack of perceived competence is noted to have a negative impact on self-management and diabetes related distress (Macrodimitis and Endler, 2001; Mohn et al, 2015; Mellergård and Johnsson, 2020) thus supporting competence and empowering those living with type 2 diabetes to feel confident in their ability to self-manage their diabetes is an important factor for healthcare professionals to consider in diabetes care.

The role of social connectedness in perceived competence in diabetes has not been explored previously, however current findings provide support for SDT (Deci and Ryan, 1985) and the role of relatedness. Results from this study support the proposal that a sense of belonging supports motivation (Deci and Ryan, 2000) and suggests that individuals who feel an increased sense of belonging feel more competent in their ability to manage diabetes and

meet the behavioural demands required of them.

Regression results also suggest that perceived competence differs across ethnicities with participants identifying as ‘white other’ and ‘mixed’ ethnicity associated with a significant decrease in perceived competence levels. Furthermore, results indicate that an increase in HbA1c is significantly associated with a decrease in perceived competence. This fits with previous research reporting that perceived competence may impact glycaemic control with greater perceived competence predicting more stable glycaemic control (Mohn et al, 2015; Mellergård et al, 2021).

Research question 3: Perceived social connectedness and diabetes distress levels

The final aim of this study was to understand if perceived social connectedness could predict diabetes distress levels. Results from hierarchical multiple regression show that social connectedness was a significant predictor of diabetes distress among individuals living with type 2 diabetes once other variables are controlled for. Results indicate that an increase in social connectedness is associated with a decrease in diabetes distress levels.

Diabetes distress is associated with increased glycaemic levels, sub-optimal self-management and increased risk of complications and hospital admissions (Fisher et al, 2010; Tareen and Tareen, 2017; Amankwah-Poku et al, 2020; Kretchy et al, 2020) thus it is important for healthcare providers to consider non-clinical factors when addressing diabetes distress (Karlsen, 2012), and this is further highlighted by current findings.

Previous research exploring the role of social support in diabetes distress indicates that social support is associated with reduced diabetes distress levels in type 2 diabetes, supporting the

link between social support and psychological wellbeing in diabetes (Gallegos-Carrilo et al, 2009; Aikens et al, 2015; Ramiksson et al, 2017; Young et al, 2020; Baek et al, 2014; Beverly et al, 2020; Chan et al, 2020). The current study indicates that perceived social connectedness is associated with a decrease in diabetes distress thus support for the SDT concept of relatedness in improving outcomes in type 2 diabetes.

Regression results also indicate that there is a significant association between those aged 26-35 and those aged 76 years and over and diabetes distress levels. Results indicate that an age of 76 or above had significantly lower diabetes distress levels whereas a younger age of between 26 and 35 is associated with higher levels of diabetes distress. These findings are consistent with previous research which has found older adults often report less exposure and reactions to daily stressors in diabetes compared to younger adults (Berg et al, 2020). Similar findings have also been reported across chronic health conditions (Chittleborough et al, 2011).

Results show that mixed ethnicity significantly predicts higher levels of diabetes distress which supports previous research where ethnicity has previously been found to be independently associated with high diabetes distress suggesting the need for awareness of differences across ethnicities and culturally relevant interventions (Schmidt et al, 2017; Özcan et al, 2018). Higher levels of HbA1c were also associated with an increase in diabetes distress levels, supporting existing research suggesting diabetes distress is associated with elevated HbA1c levels (Fisher et al 2010; Tareen and Tareen, 2017; Amankwah-Poku et al, 2020).

Post-hoc mediation analysis

Results from the post-hoc mediation analysis suggest that perceived competence in diabetes does not mediate the relationship between social connectedness and diabetes self-management. Consistent with hierarchical regression results, post-hoc analysis found that when perceived competence was included as a mediating variable between social connectedness and diabetes self-management, social connectedness predicted a significant decrease in diabetes self-management. Post-hoc analysis findings suggest that as social connectedness increases, diabetes self-management decreases among adults living with type 2 diabetes, independent of perceived competence levels. Thus, results suggest those with higher levels of perceived social connectedness are more likely to have lower levels of engagement with diabetes self-management such as diet, physical activity, medication and blood glucose monitoring. Whilst increased levels of social connectedness are related to higher levels of perceived competence in diabetes which in turn has previously been shown to have a positive impact on diabetes self-management (Williams et al, 2004; Williams et al, 2005), the current findings do not suggest perceived competence has a mediating role between social connectedness and diabetes self-management.

Impact of COVID-19

Data collection was completed between December 2020 and May 2021 when restrictions and a government lockdown were in place in response to the COVID-19 pandemic. It is therefore important to consider the findings of the current study within the context of the pandemic. COVID-19 has and continues to have an impact on individuals living with type 2 diabetes in the UK.

A study conducted in Denmark found that people living with diabetes have COVID-19 specific worries related to their diabetes, such as being at an increased risk if infected with COVID-19 and being unable to manage the demands of diabetes if infected (Joensen et al, 2020). This is supported by participants' responses in the current study. Whilst mean scores across outcomes were similar between individuals who were advised to shield at home in response to COVID-19 pandemic and those that were not, participant responses to open-ended questions provide an interesting and important insight into the impact of COVID-19 on those managing type 2 diabetes. Descriptive participant responses describe how COVID-19 has impacted on diabetes management and social connectedness. Responses indicate that COVID-19 has had an effect on management of diabetes in numerous ways including the ability to manage diabetes including attending appointments, exercise levels and dietary patterns and also psychologically. The impact on appointments included cancellation of routine appointments and long periods of time without health checks such as HbA1c tests. The impact on mental health was also highlighted including increased stress and worry, particularly due to advice that those diagnosed with diabetes are at risk of more serious illness as a result of COVID-19 from health and government officials. Participants also described the effect on self-management activities including not being able to engage in physical activity as normal and changes to eating habits making self-management of type 2 diabetes more difficult. With regards to the impact of COVID-19 on social connectedness, participants described feeling isolated due to limited social interactions and being unable to see friends and family.

Whilst the majority of responses highlighted difficulties as a result of COVID-19, it is important to note that some responses described that there were some benefits to self-management of diabetes and social connectedness including an increase in connection through online means and finding it easier to prepare healthy food. Furthermore, some

participant responses explained how COVID-19 had little or no impact on social connectedness and diabetes self-management. Nevertheless, hierarchical regression results indicate that higher levels of social connectedness are associated with lower levels of diabetes related distress and increased competence in diabetes which is consistent with previous research.

The existing literature and current findings provide an important background to consider in light of difficulties as a result COVID-19 pandemic particularly managing the demands of diabetes with potential lack of support, lack of face-to-face appointments with their healthcare team and general health anxiety. It is likely that levels of perceived social connectedness would usually be higher if social restrictions were not in place, thus it is important to consider the impact of the pandemic on current findings. Whilst findings are likely to be impacted by COVID-19, it provides a valuable insight into how the pandemic may have influenced experiences of those living with type 2 diabetes in the UK during a period of restrictions on socialising and where access to healthcare was limited. Building an understanding of the impact of COVID-19 on individuals living with type 2 diabetes is crucial to provide support with the aim to improve self-management and understand the psychosocial impact of diabetes.

Strengths and Limitations

A key strength of the current research is that it provides a picture of the role of social connectedness in type 2 diabetes, an area that has not been previously addressed. When interpreting the results of the current study, however, there are a number of considerations that should be noted. Firstly, the cross-sectional design of the study limits conclusions that can be made in regard to causation. The online nature of the study may also pose limitations

since the sample was recruited through online social media and forum channels thus may not be a representative sample of individuals living with type 2 diabetes. It can be argued that individuals with access to the internet and actively using diabetes forums may be more socially connected and engaged in their diabetes self-management thus not accessing individuals that are disconnected with no access to the internet and do not have an awareness of diabetes forums. In contrast to conducting research face to face, when distributing questionnaires online it is difficult for participants to gain further clarity on particular questions if not understood. However, this was minimised by providing researcher contact details and encouraging participants to contact the research team with any questions or clarification. Online research also raises the issue of accessibility, excluding participants without a suitable device and internet access which is required to complete the online survey. Nevertheless, conducting the study online also has an important strength as it enabled researchers to reach people across the UK regardless of location and overcome barriers posed by national lockdowns. Additional benefits to conducting online research include cost-effectiveness, time and convenience for both participants and the researcher as data collection through an online platform has the potential to collect large amounts of data efficiently with limited input from the researcher. Furthermore, participants are able to complete the survey at a time and place that is convenient for them (Wright, 2017; Regmi et al, 2016). Despite limitations, online survey platforms such as Qualtrics are increasingly popular and well-established research tools which are shown to be methodologically sound when limitations are considered and efforts are made to minimise such factors (Reips and Birnbaum, 2011; Regmi et al, 2016).

Measures used (SCS-R, DSMQ, PCDS, DDS) to obtain data on outcomes are valid and reliable and the sample size was sufficient to achieve power. Whilst SCS-R is a valid and reliable measure of social connectedness, the scale was developed in 1995 (Lee and Robbins,

1995) and questionnaire items do not incorporate technology which may impact the level of perceived social connectedness among many individuals in the present day thus should be considered when interpreting the results from the current study.

Collecting data on HbA1c levels provides a useful insight into the clinical management of participants' type 2 diabetes and is important to consider alongside psychosocial outcomes when understanding diabetes self-management. However, due to the self-report nature of HbA1c in this study, results are prone to bias and may not be accurate (Althubaiti, 2016). Demographically, the majority of the study sample (86.6%) were White British, and participants were largely female (62%). In the UK, type 2 diabetes is more prevalent in males and in minority ethnic groups, in particular those of South Asian, African and African-Caribbean origin (The Information Centre, 2008; Department of Health, 2001). The sample is therefore not representative of the typical UK demographics observed among adults living with type 2 diabetes, limiting generalisability to more diverse populations.

Furthermore, as discussed, the current study was conducted during a time where strict guidelines on socialising were in place across the UK due to the COVID-19 pandemic which may influence research findings since data was collected at a time where people are potentially more socially disconnected and experiencing unique difficulties in relation to managing their diabetes such as lack of healthcare appointments and change in dietary and exercise routines. Nevertheless, participant responses demonstrate varied experiences and results provide an important insight into the role of social connectedness in type 2 diabetes.

Theoretical implications

The SDT proposes self-determination to engage in a behaviour is a result of three needs being

fulfilled; relatedness, autonomy and competence. Previous research has highlighted the relationship between autonomy and competence (Williams and Deci, 1996; Williams et al, 1998; Williams et al, 2004; Williams et al 2009) however to date there has been lack of research on the role of relatedness in diabetes. The current study findings support the notion that the need for relatedness is associated with increased competence in diabetes and improved psychological wellbeing, as indicated by perceived social connectedness and diabetes distress scores. These findings contribute to the application of SDT to diabetes management and the positive impact of relatedness on health outcomes in diabetes.

As discussed, regression results indicate that higher levels of social connectedness predict a decrease in diabetes self-management. Such results do not support SDT which proposes that increased sense of belonging and connection with others supports self-determination, thus it would be expected that higher levels of social connectedness predict increased levels of self-management of diabetes as a result of increased self-determination to engage in self-management behaviours such as monitoring blood glucose and taking prescribed medication. Previous research exploring the role of SDT construct in diabetes self-management has found autonomy and competence are related to improved self-management and glycaemic control, whilst research on the concept of relatedness in diabetes self-management is not known to date.

The current findings suggest that social connectedness does not improve self-management in diabetes thus viewing results from a SDT lens it is possible that autonomy and competence play a more significant role than relatedness in diabetes self-management behaviours.

Findings highlight an interesting relationship between social connectedness and diabetes self-management, which can be usefully applied to improve understanding of type 2 diabetes, particularly when viewed from the lens of the SDT.

Clinical implications

Increasing understanding of psychosocial aspects of diabetes is a priority (IDF, 2019).

Healthcare professionals should take lifestyle and emotional factors into consideration to ensure successful disease management and the provision of emotional and psychological support should be an integral part of diabetes care (Diabetes UK, 2009; Young-Hyman et al, 2016). Health Psychology has the potential to improve diabetes care and the experiences of those living with type 2 diabetes by highlighting the psychosocial aspects of diabetes and potential ways to improve physical and psychological outcomes.

The findings of the current study have some important practical implications for diabetes care in the UK that can be built on with future research to increase understanding and guide interventions. Managing type 2 diabetes and related complications is costly to the healthcare system therefore understanding what supports individuals living with type 2 diabetes and potential ways to reduce complications is vital. Results from the current study indicate that social connectedness significantly predicts diabetes self-management, diabetes distress and perceived competence in diabetes which are important variables in managing the behavioural and emotional daily demands of living with type 2 diabetes. Understanding the role of social connectedness can support interventions and enable healthcare professionals to identify individuals who perceive themselves as socially disconnected. In doing so, support can be put in place to reduce diabetes distress levels and increase competence in diabetes.

Given the lack of previous research exploring diabetes distress in type 2 diabetes, the current research provides an important insight into the role of social connectedness in diabetes distress to add thus enabling healthcare professionals to support individuals living with type 2 diabetes. By understanding the potential for social connectedness to decrease diabetes related

distress levels, healthcare professionals can identify individuals at risk of increased distress levels and interventions focused on increasing social connection can be utilised to reduce distress and consequently improving diabetes outcomes and reducing complications. Furthermore, the current study adds to existing literature by providing insight into the relationship between perceived competence in diabetes and social connectedness, an area that has not been addressed in previous research. Interventions addressing diabetes distress levels and perceived competence in diabetes are likely to benefit from incorporating aspects to increase levels of perceived social connectedness among adults living with type 2 diabetes, which in turn is likely to improve diabetes self-management and outcomes as highlighted in literature.

Future research

Whilst the current study provides an important insight into the role of social connectedness in type 2 diabetes, additional research will help to increase understanding and inform future interventions. To improve on the current study, future research should include a more heterogeneous sample to improve generalisability and build on current findings. In addition, qualitative research would provide a useful understanding in how social connectedness may help to decrease diabetes distress levels and increase competence which may inform future interventions aimed at improving physical and psychological outcomes in type 2 diabetes. To date there have been no interventions targeting social connectedness among individuals living with diabetes, however past research exploring the impact of social network interventions in type 2 diabetes have shown promising results (Spencer-Bonilla et al., 2017). Future research aiming to develop and trial interventions targeting social connectedness to improve diabetes outcomes would build on the current findings and provide an insight into how to apply findings in diabetes care. Previous research (Peyrot et al, 2005) highlighted that healthcare

professionals often feel unable to engage in conversations around an individual's emotional state, thus it is important for future research to consider and explore how healthcare professionals can be supported to engage in such conversations and identify psychosocial factors that may have a negative impact on outcomes among adults living with type 2 diabetes.

Descriptive results from the current study suggest that COVID-19 has impacted those living with type 2 diabetes in relation to self-management and social connectedness. It would therefore be beneficial for future research to explore this further and increase our understanding on the long-term impact of COVID-19 on the experiences and management of individuals living with type 2 diabetes.

The current study did not explore autonomy, however findings indicate that for some, effective self-management of type 2 diabetes is possible despite lower levels of social connectedness suggesting there may be a relationship between autonomy and self-management. Future research could explore this relationship in further detail with a qualitative approach.

Conclusions

When considering the role of social connectedness for individuals living with type 2 diabetes, this study demonstrates that social connectedness predicts self-management, perceived competence and diabetes distress levels. The role of social connectedness in type 2 diabetes has not previously been explored, and SDT based research to date has focused on the concepts of autonomy and competence. Current findings therefore address a gap by adding

to our understanding of what influences self-management, competence and distress levels among adults living with type 2 diabetes and focusing on the role of relatedness.

As previously stated, the need to consider psychosocial factors in diabetes management alongside glycaemic control alone is widely acknowledged, particularly when considering that less than half of those living with type 2 diabetes achieve recommended glycaemic levels despite effective medication being available (Fisher et al, 2015; Young-Hyman et al, 2016). Previous research has not used social connectedness as a measure to explore the role in diabetes however current findings suggest social connectedness is associated with decreased diabetes distress levels, supporting past research on the role of social support in diabetes distress (Gallegos-Carrilo et al, 2009; Aikens et al, 2015; Ramiksson et al, 2017; Young et al, 2020; Baek et al, 2014; Beverly et al, 2020; Chan et al, 2020). Findings also suggest social connectedness leads to increased competence which plays a significant role in diabetes self-management as shown in previous research (Macrodimitris and Endler, 2001; Mohn et al, 2015; Mellergård and Johnsson, 2020). Such findings provide support for the SDT concept of relatedness in diabetes, as results indicate a sense of belonging may improve psychological outcomes among adults living with type 2 diabetes.

Acknowledging psychosocial factors and what may improve psychological and physical outcomes among those living with type 2 diabetes is increasingly important given the rising prevalence of type 2 diabetes in the UK and enables healthcare services and practitioners to approach diabetes care and management from a biopsychosocial approach (Engel, 1977), potentially preventing diabetes related complications and improving quality of life. Further research will extend our understanding of the role of social connectedness in diabetes and how interventions aimed at increasing social connectedness may improve physical and

psychological outcomes among adults living with type 2 diabetes in the UK, addressing the priority to increase understanding of psychosocial aspects of diabetes (IDF, 2019).

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Appendices

APPENDIX A: Ethics Approval

UWE REC REF No: HAS.20.10.031 1st December 2020
Hannah Moulson

Dear Hannah

Application title: Social connectedness, diabetes distress and self-management behaviour in individuals living with Type 2 Diabetes

Thank you for responding to the conditions raised in my letter to you of 19th November 2020. I can now confirm full ethics approval for your project, but please note the proviso below.

Please note: In light of the current situation regarding COVID-19, we can only authorise an immediate start for activities that do not breach either national laws or University policies (for further information please click on the following link <https://intranet.uwe.ac.uk/tasks-guides/Guide/research-and-enterprise-covid-19-information#part1>). In these uncertain times, law and policy may change swiftly and frequently.

We are, however, continuing to scrutinise and grant ethical approval for activities that cannot take place at present, to ensure that once the situation changes and activities can go ahead, the research is not unnecessarily delayed.

What this means for your application:

1. If your application DOES NOT involve activities affected by the current crisis (e.g. online surveys or telephone interviews etc.) then you may start your research as soon as you receive this formal notification of your ethical approval;
2. If your application DOES involve activities affected by the current crisis then you must not start your research until you are lawfully and safely able to do so, and when it does not breach the University's policies. This will affect the dates you have supplied on your application form in relation to start and finish. When you have new dates, please can you write to us in order that we can add this information to your file?

If you are a doctoral student and this will affect your research timetable, please speak to your Director of Studies and the Graduate School for advice on how time delays will be supported by the University.

Faculty of Health & Applied Sciences
Glenside Campus Blackberry Hill
Stapleton
Bristol BS16 1DD

Tel: 0117 328 1170

RESC Decision letter Full approval Version 14 1/04/2020

The following standard conditions apply to all research given ethical approval by a UWE Research Ethics Committee:

1. You must notify the relevant UWE Research Ethics Committee in advance if you wish to make significant amendments to the original application: these include any changes to the study protocol which have an ethical dimension. Please note that any changes approved by an external research ethics committee must also be communicated to the relevant UWE committee.
2. You must notify the Research Ethics Sub-Committee (formerly UREC) if you terminate your research before completion.
3. You must notify the Research Ethics Sub-Committee if there are any serious events or developments in the research that have an ethical dimension.

Please note: The RESC is required to monitor and audit the ethical conduct of research involving human participants, data and tissue conducted by academic staff, students and researchers. Your project may be selected for audit from the research projects submitted to and approved by the RESC and its committees.

We wish you well with your research. Yours sincerely

Dr Julie Woodley
Chair
Faculty Research Ethics Committee

c.c. TimMoss

APPENDIX B: Participant Information Sheet

Participant Information Sheet

Social connectedness, diabetes distress and self-management behaviour in individuals living with Type 2 Diabetes.

You are invited to take part in research taking place at the University of the West of England, Bristol. Before you decide whether to take part, it is important for you to understand why the study is being done and what it will involve. Please read the following information carefully and if you have any queries or would like more information please contact Hannah Moulson (hannah2.moulson@live.uwe.ac.uk).

Who is organising the research?

The lead researcher is Hannah Moulson, a Trainee Health Psychologist undertaking the professional doctorate in Health Psychology at the University of West England. The research will be supervised by Tim Moss (Tim.Moss@uwe.ac.uk) and Amy Slater (Amy.Slater@uwe.ac.uk)

What is the aim of the research?

This research aims to understand the impact of perceived social connectedness (how connected an individual feels to others) on diabetes related distress and self-management behaviours among individuals living with type 2 diabetes.

Our research questions are:

1) How is self-management behaviour influenced by levels of perceived social connectedness among individuals living with diabetes?

2) How does social connectedness influence diabetes distress among individuals living with type 2 diabetes?

3) How does social connectedness influence perceived competence among individuals living with type 2 diabetes?

Why have I been invited to take part?

As an individual living with Type 2 Diabetes we are interested in gaining information about your experiences related to social connectedness, diabetes distress, and the management of diabetes to understand more about how management may be influenced. The questionnaires will ask you about these and you will be asked to select a score that matches how you feel.

What are the requirements to take part?

You must be a UK resident aged 18 or over and have a diagnosis of type 2 diabetes (diabetes mellitus) to take part in this study.

If any of the below apply to you, unfortunately you will not be able to take part:

- Diagnosis of a different type of diabetes e.g. Type 1 diabetes, or gestational diabetes
- Unable to read and write English
- A severe co-morbidity (other health condition) e.g. end-stage renal disease, terminal cancer.

If you wish to discuss any of the above criteria or are unsure whether you are eligible to take part, please do not hesitate to contact the research team using the contact details provided on this form.

Do I have to take part?

Taking part in this research is entirely voluntary and you can withdraw your consent at any point by contacting the research team (Hannah2.Moulson@live.uwe.ac.uk) stating that you wish to withdraw from the study. You are not required to give a reason for withdrawal, however you must provide the anonymous participant number created during the survey which will enable us to identify which responses must be withdrawn. You are able to withdraw from the study **up to 1 month after the date of completing the study.**

It is completely up to you to decide whether you want to be involved and you do not need to provide a reason if you decide not to take part. If you do take part, you will be provided with a copy of this information to keep and will be asked to sign a consent form.

What will happen to me if I take part and what do I have to do?

If you agree to take part in this study you will be asked to create an anonymous participant number before completing a series of short questionnaires which will ask you to select a score that best describes how you feel. The questionnaires will take around 20 minutes to complete in total and you are able to withdraw from the study at any time if you no longer wish to take part.

What are the benefits of taking part?

By taking part in this study, you will contribute to the research in this area and help us to gain a better understand of how social connectedness may influence how individuals living with type 2 diabetes manage and experience their diabetes. This is a unique opportunity to improve understanding of others and inform healthcare.

What are the possible risks of taking part?

We do not foresee or anticipate any significant risk to you in taking part in this study, however if you feel uncomfortable at any time you can stop completing the questionnaires. The research team are experienced in conducting research and are sensitive to the subject area. If you need any further support the researchers will be able to put you in touch with suitable support agencies.

How will my data be used?

Data will be used for research purposes only and no identifying information will be collected. All the information that you give will be kept confidential and anonymised. We take robust approach to protecting data with secure electronic storage areas with controlled access.

UWE Bristol is committed to protecting the privacy and security of your personal data in accordance with Data Protection Act 2018 and General Data Protection Regulation (GDPR). We will always respond to concerns or queries you may have. If you have any data protection queries, please contact UWE Bristol's Data Protection Officer (dataprotection@uwe.ac.uk).

Where will the results of the research study be published?

A Report will be written containing our research findings and will be available on the University of the West of England's open-access Research Repository and a copy of the report will be made available to all research participants on request. The research may also be submitted for publication in an academic journal.

Who has ethically approved this research?

The project has been reviewed and approved by the University of the West of England University Research Ethics Committee. Any comments, questions or complaints about the ethical conduct of this study can be addressed to the Research Ethics Committee at the University of the West of England at: Researchethics@uwe.ac.uk

What if I have more questions or do not understand something?

If you would like any further information about the research, please contact Hannah Moulson, Trainee Health Psychologist: hannah2.moulson@live.uwe.ac.uk

APPENDIX C: Participant Consent Form

Participant Consent Form

Social connectedness, diabetes distress and self-management behaviour in individuals living with Type 2 Diabetes.

Please ensure that you have read and understood the information contained in the Participant Information Sheet and asked any questions you may have before you sign this form. If you have any questions please contact a member of the research team, whose details are set out on the Participant Information Sheet.

Please read the below statements:

- I have read and understood the information in the Participant Information Sheet;
- I have been given the opportunity to ask questions about the study;
- I have had any questions (if applicable) answered satisfactorily by the research team;
- I understand that my participation is voluntary and that I am free to withdraw from the research up to one month following survey completion, without giving a reason and without disadvantage to myself by contacting the research team using the contact details provided in the information sheet.

If you are happy to take part in this study and complete a series of questionnaires related to living with diabetes, please confirm that you agree to take part in the research below.

I agree to take part in the research

APPENDIX D: Participant Debrief Sheet

Participant Debrief Sheet

Social connectedness, diabetes distress and self-management behaviour in individuals living with Type 2 Diabetes.

Thank you for taking part.

Your participation is appreciated, and we hope that you have found it interesting. If you have any comments or concerns about the study please contact me (Hannah2.Moulson@live.uwe.ac.uk).

If you wish to withdraw from the study you are free to do so up to one month after you have completed the study by contacting the research team on the email above and requesting to withdraw from the study. You do not need to provide a reason for your withdrawal, however for the purposes of identifying the correct data you will need to provide the anonymous participant number you created at the start of the survey so please ensure you have made a note of this.

If you would like further information about the study or would like to know about the findings once data has been collected and analysed, please contact me on the above email. I cannot however provide you with individual results.

Thank you for your time

APPENDIX E: Demographic Questionnaire**Demographic Questionnaire****Gender:**

- Male (including transgender men)
- Female (including transgender woman)
- Other (including non-binary, gender fluid)
- Prefer not to say

Age:

- 18-25
- 26-35
- 36-45
- 46-55
- 56-65
- 66-75
- 75+

Marital status:

- Single (never married)
- Married
- Living with partner
- Divorced/separated
- Widowed

Please state ethnicity:

- White British
- White other
- Asian
- Asian British
- Black
- Black British
- Mixed
- Other ethnic group

Are you currently taking medication to manage your diabetes?

- No, I am not prescribed medication for my diabetes
- Yes, tablets
- Yes, insulin
- Yes, both tablets and insulin

Years since diagnosis (duration of diabetes): []

Current/latest HbA1c (if known): *Please use either % or mmol/mol* []

APPENDIX F: Social Connectedness Scale – Revised (SCS-R)**Social Connectedness Scale – Revised**

Directions: Following are a number of statements that reflect various ways in which we view ourselves. Rate the degree to which you agree or disagree with each statement using the following scale (1 = Strongly Disagree and 6 = Strongly Agree). There is no right or wrong answer. Do not spend too much time with any one statement and do not leave any unanswered.

	Strongly Disagree 1	Disagree 2	Mildly Disagree 3	Mildly Agree 4	Agree 5	Strongly Agree 6
	Strongly Disagree			Strongly Agree		
1. I feel comfortable in the presence of strangers.....	1	2	3	4	5	6
2. I am in tune with the world.....	1	2	3	4	5	6
3. * Even among my friends, there is no sense of brother/sisterhood.....	1	2	3	4	5	6
4. I fit in well in new situations.....	1	2	3	4	5	6
5. I feel close to people.....	1	2	3	4	5	6
6. I feel disconnected from the world around me.....	1	2	3	4	5	6
7. Even around people I know, I don't feel that I really belong.	1	2	3	4	5	6
8. I see people as friendly and approachable.....	1	2	3	4	5	6
9. I feel like an outsider.....	1	2	3	4	5	6
10. I feel understood by the people I know.....	1	2	3	4	5	6
11. I feel distant from people.....	1	2	3	4	5	6
12. I am able to relate to my peers.....	1	2	3	4	5	6
13. I have little sense of togetherness with my peers.....	1	2	3	4	5	6
14. I find myself actively involved in people's lives.....	1	2	3	4	5	6
15. I catch myself losing a sense of connectedness with society.....	1	2	3	4	5	6
16. I am able to connect with other people.....	1	2	3	4	5	6
17. I see myself as a loner.....	1	2	3	4	5	6
18. I don't feel related to most people.....	1	2	3	4	5	6
19. My friends feel like family.....	1	2	3	4	5	6
20. I don't feel I participate with anyone or any group...	1	2	3	4	5	6

APPENDIX G: Diabetes Self-Management Questionnaire (DSMQ)**Diabetes Self-Management Questionnaire (DSMQ)**

The following statements describe self-care activities related to your diabetes. Thinking about your self-care over the last 8 weeks , please specify the extent to which each statement applies to you.	applies to me very much	applies to me to a considerable degree	applies to me to some degree	does not apply to me
1. I check my blood sugar levels with care and attention. <input type="checkbox"/> <i>Blood sugar measurement is not required as a part of my treatment.</i>	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0
2. The food I choose to eat makes it easy to achieve optimal blood sugar levels.	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0
3. I keep all doctors' appointments recommended for my diabetes treatment.	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0
4. I take my diabetes medication (e. g. insulin, tablets) as prescribed. <input type="checkbox"/> <i>Diabetes medication/insulin is not required as a part of my treatment.</i>	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0
5. Occasionally I eat lots of sweets or other foods rich in carbohydrates.	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0
6. I record my blood sugar levels regularly (or analyse the value chart with my blood glucose meter). <input type="checkbox"/> <i>Blood sugar measurement is not required as a part of my treatment.</i>	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0
7. I tend to avoid diabetes-related doctors' appointments.	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0
8. I do regular physical activity to achieve optimal blood sugar levels.	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0
9. I strictly follow the dietary recommendations given by my doctor or diabetes specialist.	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0
10. I do not check my blood sugar levels frequently enough as would be required for achieving good blood glucose control. <input type="checkbox"/> <i>Blood sugar measurement is not required as a part of my treatment.</i>	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0
11. I avoid physical activity, although it would improve my diabetes.	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0
12. I tend to forget to take or skip my diabetes medication (e. g. insulin, tablets). <input type="checkbox"/> <i>Diabetes medication/insulin is not required as a part of my treatment.</i>	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0
13. Sometimes I have real 'food binges' (not triggered by hypoglycaemia).	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0
14. Regarding my diabetes care, I should see my medical practitioner(s) more often.	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0
15. I tend to skip planned physical activity.	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0
16. My diabetes self-care is poor.	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> 0

APPENDIX H: Perceived Competence in Diabetes Scale (PCDS)**Perceived Competence for Diabetes Scale - PCDS**

Please respond to each of the following items in terms of how true it is for you with respect to dealing with your diabetes. Use the scale:

1. I feel confident in my ability to manage my diabetes.

1	2	3	4	5	6	7
not at all true		somewhat true			very true	

2. I am capable of handling my diabetes now.

1	2	3	4	5	6	7
not at all true		somewhat true			very true	

3. I am able to do my own routine diabetic care now.

1	2	3	4	5	6	7
not at all true		somewhat true			very true	

4. I feel able to meet the challenge of controlling my diabetes.

1	2	3	4	5	6	7
not at all true		somewhat true			very true	

APPENDIX I: Diabetes Distress Scale (DDS17)**Diabetes Distress Scale (DDS)**

DIRECTIONS: Living with diabetes can sometimes be tough. There may be many problems and hassles concerning diabetes and they can vary greatly in severity. Problems may range from minor hassles to major life difficulties. Listed below are 17 potential problem areas that people with diabetes may experience. Consider the degree to which each of the 17 items may have distressed or bothered you DURING THE PAST MONTH and select the appropriate number.

Please note that we are asking you to indicate the degree to which each item may be bothering you in your life, NOT whether the item is merely true for you. If you feel that a particular item is not a bother or a problem for you, you would select “1”. If it is very troublesome to you, you might select “6”.

	Not a problem	A slight problem	A moderate problem	A somewhat serious problem	A serious problem	A very serious problem
1. Feeling that diabetes is taking up too much of my mental and physical energy every day. Feeling that my doctor doesn't know enough about diabetes and diabetes care.	1	2	3	4	5	6
2. Feeling that my doctor doesn't know enough about diabetes and diabetes care.	1	2	3	4	5	6
3. Feeling angry, scared and/or depressed when I think about living with diabetes.	1	2	3	4	5	6
4. Feeling that my doctor doesn't give me clear enough directions on how to manage my diabetes.	1	2	3	4	5	6
5. Feeling that I am not testing my blood sugars frequently enough.	1	2	3	4	5	6
6. Feeling that I am often failing with my diabetes routine.	1	2	3	4	5	6
7. Feeling that friends or family are not supportive enough of self-care efforts (e.g. planning activities that conflict with my schedule, encouraging me to eat the “wrong” foods).	1	2	3	4	5	6
8. Feeling that diabetes controls my life.	1	2	3	4	5	6
9. Feeling that my doctor doesn't take my concerns seriously enough.	1	2	3	4	5	6

10. Not feeling confident in my day-to-day ability to manage diabetes.	1	2	3	4	5	6
11. Feeling that I will end up with serious long-term complications no matter what I do.	1	2	3	4	5	6
12. Feeling that I am not sticking closely enough to a good meal plan.	1	2	3	4	5	6
13. Feeling that friends or family don't appreciate how difficult living with diabetes can be.	1	2	3	4	5	6
14. Feeling overwhelmed by the demands of living with diabetes.	1	2	3	4	5	6
15. Feeling that I don't have a doctor who I can see regularly enough about my diabetes.	1	2	3	4	5	6
16. Not feeling motivated to keep up my diabetes self-management.	1	2	3	4	5	6
17. Feeling that friends or family don't give me the emotional support that I would like.	1	2	3	4	5	6

APPENDIX J: Participant COVID-19 responses**Participant responses: Impact of COVID-19 on diabetes management****Appointments/contact with healthcare team**

- Worsened it as all appointments and routine checks have been cancelled
- All help is on-line - less opportunity for face-to-face medical appointments More difficult to exercise
- Missed annual check ups and blood tests
- It was a very long time before I could see my diabetes specialist doctor as all of my appointments were cancelled during the lockdowns of 2020.
- Not had a diabetic health check during the pandemic.
- Made it worse as got stressed and ate things I shouldn't have
- Doctors wouldn't let me do my yearly blood sugar level test
- i think it has affected me a great deal as i dont feel comfortable going to appointments
- I have been less able to go for routine tests and only had telephone appointments recently
- Unable to have regular check ups.
- My retinopathy and annual foot care appointments were cancelled in 2020 which was a worry. i follow a keto diet and it was sometimes difficult to get some of the items I rely on
- UNABLE TO SEE DR
- Have not had an appointment for 2 years so no idea whats its like
- I have had a review with the practice nurse by telephone. I was promised my self analysis form (a form where the % and numerical results from the pre-assessment blood test are written so I can plan my conversation around the issues as necessary) back before the tele consult but this did not happen so it made the appointment less pointed.
- It hasn't affected it much other than less doctors appointments to discuss issues

- Unable to see doctors and practice nurse because of preoccupation with covid
- it have led to unstable access of health care services.
- It has made it easier to avoid drs appointments and has made it harder to exercise with gyms shut
- Yes no annual review
- Being left for 18 months with no blood test for Hba1c and then finding my levels had gone up, not receiving my annual retinopathy at the hospital
- I haven't had a blood test the whole time, I had one phone call from the nurse and that's it. I have struggled with eating healthily with all the anxiety. I have new related scary symptoms but don't feel I can contact the doctor about it due to the pandemic
- It made it harder as I wasn't able to see my doctor

Stress/mental health/fear

- I have existing medical issues that cause issues with mobility so combined the fear of coronavirus is terrifying
- It made it worse stress induced hyperglycaemia
- its been less under control due to stress
- More at risk
- makes me more worried
- It reminded me that I am more vulnerable.
- I think what troubles me most is that I suffered from moderate/severe covid and was treated in hospital for over a week. This was in February 2021, I have felt like I've had long covid, and I worry what the effects of having covid and long covid are on diabetic patients. Especially with regards to neuropathy as I suffer with sciatica and other nerve pain, I'm fearful that after having covid my nerve pain could increase.
- Scared me and made me aware and try to lose weight

management (exercise, diet)

- Not able to go out as much
- Can't go shops for groceries as often

- Lack of exercise in gym and pool
- Impact of lock down and staying at home has increased the amount of snacking
- Restricted to online food shopping.
- I have been quite low at times which leads to comfort eating the wrong foods. Also I have not always been able to get face to face appointments and have had to settle for telephone appointments which isn't the same.
- more difficult
- MAJORLY AS NO GYM LOW FOOD AVAILABILITY TO START
- Stopped me swimming and doing exercise I enjoy. Also, only finding enjoyment in food and being in lockdown with nothing else to do but eat is hard. I've been so good since 4th January but this last week I've felt it all slipping away again.
- I've eaten more unhealthily
- I am taking less exercise outdoors because of being shielded and living in a big city where it is difficult to walk alone. I miss walking in the countryside and being able to go swimming.
- Much harder to handle
- made it difficult to stick to a good diet by being alone and reliant on grocery deliveries
- Outdoor exercise has become more restricted
- I am eating a bit more of the foods I shouldn't during lockdown
- Chose to shield as much as possible to protect myself and husband who is also diabetic, meaning less choice for food shopping due to being restricted by availability of supermarket deliveries. Also on a low income so there are restrictions on what we can spend on food, which has been made worse by the pandemic because of price rises, unavailability of certain food items in our weekly online shop with the only alternatives being more expensive and unaffordable, plus not having the choice to go elsewhere due to shielding.
- It has made it slightly worse as I have less of a routine at home. I do take my medication, but I often have to be reminded to take it whereas I used to always remember to do it at a certain time. It feels easier to lose track of time during the pandemic.

- Made it worse as I'm working from home and eating more
- IVE BEEN EATING MORE CARBS
- Slightly less exercise
- I have felt less willing to go outside to exercise
- Initially, when lockdowns began and I was shielding, I found it hard to get food deliveries from supermarkets which meant having a greater reliance on takeaway foods, which was not ideal for meal planning.
- There was a period of time where my eating was poor and i was not following my diet. My sugar levels were too high. However i returned to eating better and sugar levels have come down.
- I worked extra hours to cover shielding colleagues, sometimes I didn't have time/energy to eat well.
- By being less active and when the pandemic first struck , it was somewhat difficult to always get the right food I eat on a regular basis
- At the beginning during the first lockdown I was able to manage my diabetes amazingly. Now I feel like I am slipping into worse habits than before
- It has probably affected me as due to COVID i have been less active. I am now working from home and sitting down at a computer whereas I would have been out visiting clients and walking a lot more. I have tried to lose weight but the boredom of being in the house all day just makes me want to eat.
- Exercise restricted as gym closed
- My life has been work and home with little else in between. I have become quite lazy in my control over the last year. At present I feel that the diabetes count is likely to have gone up since my last check.
- The annual diabetic check was put on hold for a few months. I tend to comfort eat and tend to eat the wrong thing when I worry or stress about life. I put on weight because of this.
- Shopping (or not) for groceries. I self isolated so husband did the shopping instore, he did not take enough care e.g. looking at ingredients for high carb/sugar content. I had to 'nag' more.
- Eating too many bad things by being stuck indoors for so long.
- IT HAS PREVENTED ME FROM EXERCISING AS MUCH.

- Stressful so haven't always eaten the way I should - congruity eating, put on a bit of weight
- My diet has become worse and I have been doing less exercise so the pandemic has been detrimental.
- During lockdown I found I wasn't eating as healthily as I should do (ie comfort eating, craving chocolate to cheer myself up etc)
- following first inoculation sugar levels were raised
- reduced my daily exercise
- I had some difficulty at first getting the right kinds of food. Supermarkets were stripped bare and then I had to shield. Was given emergency government food parcels but they were often not suitable. Couldn't get a supermarket delivery service slot for the first 7 weeks.
- Its hard not having face to face appointments
- Badly. I have become lazy.
- It has made it harder to get some foods and also I am more sedentary
- I don't feel as able to have routine diabetes management
- I've been working from home which has led to reduced activity, as I normally walk to work three times a week. Also I've not had a retinopathy test for a while. Otherwise, nothing else has changed.
- my work situation has become more stressful and time consuming, which in turn has led to me being less active with my diabetes care.

Positive impact

- It has made it better, I meal plan for two to three weeks at a time now and am less inclined to buy and eat less healthy food as I do not go to the shops much.
- I've been more careful and really increased my activity levels, joined a walking group and trampoline classes
- Actually helped to a degree as went on more walks
- It has made it easier due to no eating out and managing own food at home instead of a hotel

- During the pandemic I was switched from tablets alone to insulin and tablets. I have found it easier to keep on top of my glucose levels since being on both. The pandemic has meant working fullu from home and has made it easier to "learn" how to use insulin.
- I have been more aware of needing to take care of myself since receiving a shielding letter.
- I feel like it has allowed me to manage my food better as I am working from home. There's less temptation to eat poorly
- Not at all, I have been able to do even more exercise during lockdown (I mainly use an exercise bike).
- easier to manage as I amworking at home
- Probably for the better as I now think more deeply what I put on supermarket delivery orders
- I increased my exercise to keep myself in shape

No impact

- not at all
- Not affected it at all
- Yes
- It hasn't really, just snacking is a problem so it has hightened my blood sugar levels
- Only been diagnosed 4 months ago so not really had an affect on me.
- No
- Ok
- It hasn't I have still had good communication with my doctor/nurse
- I dont think it has really
- I don't feel it has changed how I manage my diabetes at all.

- not at all
- None
- No affect
- No change
- Not at all
- It has not affected it.
- same as always
- No not really
- Not affected it at all.
- It has no affect how i manage the diabetes
- It has not affected my diabetes
- Minimal effect on me
- It has had no significant change. I have maintained the government's guidelines stringently of social distancing, hygiene and masks..
- It do not affect me as I had kit at home to check and know already not to eat cretin foods drinks
- no change
- It hasn't affected me
- No affect
- NOT AT ALL
- No
- It hasn't really impacted my life
- NOT REALLY AFFECTED AT ALL
- No

- The pandemic has no impact on my diabetes management
- it hasn't my management is as bad before as it is now
- It hasn't
- not at all
- No change whatsoever
- no change
- No problems
- no change
- Not so much. I have other health conditions that are more of a concern
- Not much
- Not at all
- I'm more careful now than ever
- Has had no impact

Participant responses: Impact of COVID-19 on social connectedness

Negative impact on social connectedness

- Badly. I am no longer a part of young family members' regular life.
- I feel increasingly isolated and have only had a few social interactions in over 12 months
- It has affected me in a very negative way, I lost my job just before the pandemic and then had to shield. I do speak to my family on the phone once a week, but that is my only social contact apart from when I go to the shops about once every three to four weeks.
- not able to go out and meet up with people

-
- I'm still connected to the local community via my work and online volunteering. But as somebody who generally prefers being at home, I do feel I've become more insular and reluctant to go out.
- I have missed meeting with my sister and the rest of the family. Last Christmas basically didn't exist.
- its affected that quite a lot as theirs new friends i recently made & havent been able to keep i8n touch
- not being able to see my children & grandchildren has been uncomfortable
- i stay in a lot more since the first lockdown
- It's made me more agoraphobic, but I am improving now. I haven't spoken to anyone outside my house for weeks at a time. But I have a lot of people online to talk to. That has increased over the pandemic, as I got into new things and joined groups related to them and made some good friends. I wouldn't say I entirely feel like I belong but I feel like I have people to chat to at any time.
- Oh loads. One of the things I loved most in my life was having friends and family come round for dinner. Feel distanced and isolated from them, in own little bubble with husband and minimal other interaction, but when that interaction does happen it can feel like too much
- It made it harder as every one was avoiding each other
- I feel somewhat isolated but I have especially felt disconnected to work. Shielding while others were going to work made me feel very separate.
- At the beginning I felt more connected but right now I feel a lack of community and feel some people behave very selfishly.
- Although I have not been isolated during the pandemic (I live with my husband, and have social connectedness via video calls for work and with friends) I have become very nervous of going out of the house again now that the restrictions are starting to lift.
- i feel isolated and depressed
- Not able to go and see families and friends

- not going out as made me feel isolated
- i have felt very alone at times
- My hooby of warhammer gaming has stopped and I miss all my fellow gamers which would have been at least once a week.
- Its made me nervous and a bit shy meeting people again.
- not mixing and getting out
- I MISS GOING OUT ESPECIALLY TO THE SEASIDE AND HOLIDAYS
- Very isolated. At home so much and now everyone can go out im.still wary
- HAS BEEN HARD BUT THERE ARE PEOPLE IN WORSE PROBLEMS THAN ME
- I feel like I've missed a whole year
- I often wonder if this is where I'm supposed to be, I think what's the point, I think why bother, who would miss me if I wasn't here, the answer would be few. But witnessing what this pandemic has done globally, the amount of death that it's caused, and that I've somehow managed to beat it. That gives me a much higher sense of belonging and I feel like yhe world may have finally accepted me.
- As was told to work from home in March 2020. This has been very hard as I work in a university and normally have a lot of human contact. I have missed out on a lot this last year. I have been isolated and being apart from others has had a significant effect.
- I have completely detached from people I was not particularly close to and have isolated myself from everyone other than a couple of my closest friends.
- dont feel a sense of belonging to anything
- I used to visit my friends and family and certainly during lockdown I haven't been able to see my family as much. I was a real huggy person and it just feels as if I have lost some of that connection certainly with my children who don't live with me. It's awful.
- Social connectedness has become a lot less due to the distancing and non-mixing rules in place.
- Im pretty much a loner mother with son only sense of effect is job lose with cleanings that all

- had to stop playing my sport
- Lost my job and no longer a part of a team
- I have lost degree of contact with others. Not being able to see family or friends for so much of the last year has made me feel cocooned.
- It has had a huge affect on me. Lockdowns in particular. I love my family dearly and not being able to meet them or hug them has been very difficult.
- Thank goodness for Zoom, but other than this I felt isolated from family and friends. It has been difficult.
- Major effect. My wife is immune suppressed so we have not left the house apart from medical appointments for over a year now.
- I feel disconnected from people who I was close to previously
- It really made me feel lonely but I still belonged.
- IVE BEEN MUCH MORE INTROVERTED
- I ve got isolated somehow from the society
- I am finding it difficult to get back into "normal life." While others around me are keen to go out, I am still happy to stay at home.
- Missed friends and family
- Very isolated. No family near. Social distancing.
- it have lowered the friendship degree due to suspension of public meetings and face to face social groups.
- It has been a very challenging and difficult time.
- To a slight degree as we can no longer socialise
- feel disassociated from society
- My GP suggested I shield although not officially at risk so I have been out 14 times in the past year mainly for medical appointments.
- Have barely left the house so haven't seen friends and relatives for a long time.
- lock down and social distancing means not seeing people as much

- Just like everyone else, socialising with people outside my household has become almost impossible. I particularly miss seeing family members.
- lack of almost all social interaction has negatively affected my social connectedness
- As it has gone on I have felt depressed and less able to find the motivation to connect with others
- I no longer know how to socialize
- MAde it worse as haven't been out much
- As a sufferer of Social Anxiety, Depression and Agoraphobia, being in lockdown for over a year has severely affected my Mental Health detrimentally.
- a lot i dont see many people and i am mostly confined to my home
- I've been isolated for over a year which has broken my mental health. I haven't been able to see or hug my mum in over a year, I haven't been able to have social activities with my friends. I've been lonely and very depressed.
- I am isolated from everyone now, just my immediate family
- Total suspension of amateur theatre activities. I Skype call weekly an old friend who pre pandemic I met with once a fortnight for lunch.
- BIG WITH FITNESS
- slightly worse
- It was very difficult to connect with people again due to new measurements put in place by national governments and social distancing was enforced which was a completely new thing to do. Felt very isolated during the pandemic though I never run out of medications. I still managed to keep my daily routine of diabetes care in check.
- working from home/no family affected sense of belonging
- other mobility issue causes lack of connectedness so combination
- I miss meeting up with my family, we have a new granddaughter who we haven't been able to see for months on end, I miss meeting up with my friends. I also miss attending Slimming World which helps me with my weight in order to keep my diabetes under control, again I have been attending Slimming World online but its not the same.

- lack of social support due to pandemic has reduced connectedness
- Unable to attend group support sessions. Increased feeling of isolation
- Worsened it as I used to see others at organised groups and activities eg playing in an orchestra and at church but I have not met anyone socially since March now
- I feel isolated and removed from other people less at risk from covid complications
- Less connection with friends, and work colleagues due to WFH so every 'iffy' mood gets amplified as less opportunity to natter about things and release the tension.
- Yes
- I feel that I have lost connections with people as I cannot see them anymore
- Became more depressed
- More depressing, can't socialise offline as much
- Lack of exercise in gym and pool
- Struggling
- Working from home
- the less I've seen people the less I want to see people. My brain doesn't have time for people on text or email at the moment. Just feel like I need space all the time

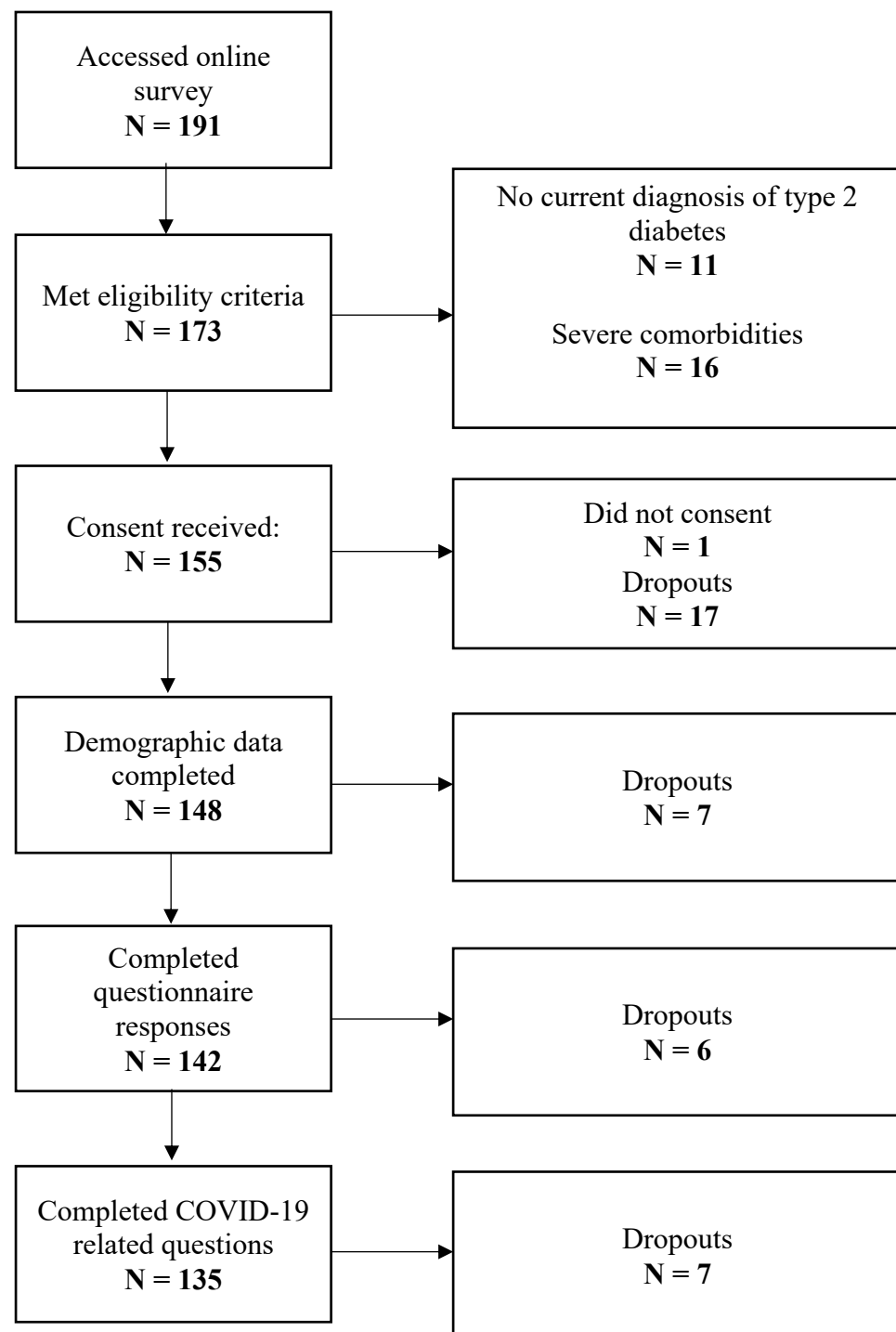
Positive impact

- Not at all. If anything it has built a bigger sense of community in my social world through online means.
- no real change - if anything it increased my sense of belonging
- I feel that it has positives and benefits. I have spent more time online and have been able to communicate with friends there more, but I also feel very lonely at times being at home and not being able to go out.
- I feel it has got better because I make more effort to contact people by other means.
- In no other way than if I didn't have diabetes - it obviously has changed us all

No impact

- None
- Not at all
- Not at all
- The Corona virus has had no impact on social connectedness (sense of belonging).
- NO EFFECT
- To the same degree as everyone else I think. I've been quite isolated but I don't really mind that.
- I do not believe it has.
- not at all
- No problem
- No change
- i am ok on my own or in my family setting.
- None
- I do not feel that it has had an effect on this issue.
- not at all. I avoid social things anyway.
- Hasn't affected me
- not been effected
- It hasn't affected my social connectedness, as I was purposely quite distant from people as a choice before Covid
- I had little social interaction prior to the pandemic, so very little has changed.
- None what so ever
- It hasn't changed

- no effect
- Hasn't affected it at all, I was lone working by myself before the pandemic and am now lone working from home.
- No mote than anyone else
- I don't think it has
- It hasn't affected it to a huge degree as I still talk with friends on the phone and over Zoom
- i dont know
- I see people in person less but I still stay connected via telephone and zoom, etc.
- Not at all
- No change
- Sometimes very rarely i feel disconnected mainly as i live by myself
- I don't think it has
- It hasn't
- not at all
- We just Skype, call and chat online. A lot of our friends and family live a distance away, so that's fairly normal for us.
- none
- Always felt the same way the older ive got
- Not at all, I work on the frontline so have still been seeing colleagues.
- I see quite a few people as I'm a carer in the community and 5 of us living in e so don't feel any loss of sense of belonging
- Ok
- not at all. there have been plenty of interactions using the internet.
- Not much different to usual.
- In a household where my husband is diabetic so we can support each other


APPENDIX K: Flow diagram showing participant dropout**Flow chart of survey responses and participant eligibility**

APPENDIX L: Systematic Review

DIABETICMedicine

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Systematic Review or Meta-Analysis

What psychosocial interventions work to reduce hospital admissions in people with diabetes and elevated HbA_{1c}: a systematic review of the evidenceH. Moulson , S. Sanders, S. Coppin and J. Meyrick

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Abstract

Background Diabetes is a chronic condition that can lead to devastating complications if not managed effectively. Individuals with elevated HbA_{1c} are at higher risk of developing complications resulting in diabetes-related hospital admissions, an additional pressure and expense for healthcare systems.

Aim To systematically review evidence of the effectiveness of psychosocial interventions among individuals with elevated HbA_{1c}, as indicated by hospital admissions.

Methods Electronic databases (MEDLINE, PsychINFO, CINAHL, AMED, Embase and Scopus) were used to identify studies systematically. Studies were screened against eligibility criteria and included if they evaluated the effectiveness of a psychosocial intervention on diabetes-related hospital admissions in individuals with elevated HbA_{1c}. Risk of bias was assessed using the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies, and a narrative synthesis was conducted.

Results Of 15 362 studies, five were included in the review. Psychosocial interventions were found to significantly reduce diabetes-related hospital admissions in four of these studies and interventions involving psychotherapy in particular were found to reduce admissions. The methodological quality of studies ranged from weak to moderate, due to lack of blinding, weak study design and issues with withdrawals and drop-outs.

Conclusions Psychosocial interventions may reduce diabetes-related hospital admissions in individuals with elevated HbA_{1c}; however, due to variability in methodological rigour, the conclusion remains tentative. Further research targeting this group, particularly within the adult population, is recommended. (PROSPERO registration number: CRD42019133456).

Diabet. Med. 37, 1280–1290 (2020)

Introduction

It is reported that the National Health Service (NHS) spends at least £10bn per year on diabetes, with almost 80% of this money spent on treating complications, many of which are preventable [1]. When diabetes is uncontrolled, there are increased healthcare costs resulting from costly complications such as diabetic ketoacidosis, heart disease, blindness and kidney failure which are often preventable through

ongoing glycaemic control [2,3,4,5,6]. Ketoacidosis is a frequent occurrence among people with diabetes who have elevated HbA_{1c} levels, particularly among adolescents with type 1 diabetes, and is often preventable [7]. Such admissions cost the NHS £2064 per adult treated and £1387 per adolescent treated [8,9]. Reducing ketoacidosis admissions as well as other diabetes-related complications will significantly reduce NHS costs. Since the risk of hospitalisation for individuals with diabetes is almost twice that of others [10,11] it is important to understand which interventions are effective among people with diabetes and elevated HbA_{1c}, with the goal of reducing admissions.

HbA_{1c} levels provide a good indication of glycaemic control, with levels of 53 mmol/mol (7.0%) or below indicating good glycaemic control with risk of complications

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What's new?

- People with diabetes and elevated HbA_{1c} concentrations are more likely to develop complications resulting in hospital admissions. Psychosocial factors play a key role in determining self-management outcomes, and psychosocial interventions are shown to improve psychological well-being and physical health outcomes.
- This review found that psychosocial interventions, in particular psychotherapy, may reduce hospital admissions among individuals with diabetes who have elevated HbA_{1c}.
- Results indicate that designing and testing psychosocial interventions targeting individuals with elevated HbA_{1c} has the potential to improve psychological well-being and therefore reduce preventable hospital admissions and associated costs among this population.

at a similar level to that of the general population, and levels of 58 mmol/mol (7.5%) and above indicating substantial risk of complications and the need for further intervention [12]. Crucially, individuals with elevated HbA_{1c} are more likely to have higher utilisation of healthcare services, resulting in additional costs for the healthcare system [13].

Elevated HbA_{1c} is likely to stem from a wide range of psychosocial factors, and the interventions examined in the present review are therefore limited to this category.

Although diabetes is a physiological disease with effective medication available, management is largely behavioural [14]. It is well recognized that environmental, social, behavioural and emotional factors, known as psychosocial factors, play a key role in determining management outcomes in individuals with diabetes [6,15]. Psychosocial difficulties impact an individual's ability to undertake the extensive behavioural demands required to effectively manage diabetes, and it is estimated that up to a third of those living with diabetes experience such difficulties [16,17,18,19,20]. As a result of these difficulties, many individuals with diabetes do not achieve optimal blood glucose control even with an effective medication regime in place.

Many individuals living with diabetes experience diabetes distress, as a result of becoming overwhelmed by the demands of diabetes. High levels of diabetes-related distress are linked to elevated HbA_{1c} and a decline in self-management as individuals experience 'diabetes burnout', increasing the risk of diabetes-related complications and hospital admissions [21]. This is also found with other mental health problems including anxiety and depression, and there is consistent evidence that diabetic ketoacidosis presentations are associated with psychological difficulties [16,22]. Such psychological comorbidities interfere with the person's ability to carry out diabetes self-management and are associated with reduced adherence to treatment and increased risk of diabetes complications [23].

It is widely recognised that psychosocial care should be integrated with a collaborative approach to optimise health outcomes and health-related quality of life [24]. Lack of adequate psychosocial support is shown to have a negative effect on various outcomes, including blood glucose control, thus psychosocial support is an integral part of diabetes care and should be accessible to individuals living with diabetes [25,26]. Psychosocial interventions are associated with a reduction in psychological and diabetes-related distress, improved quality of life and reported self-management in individuals with diabetes [27,28,29]. There is also evidence that psychosocial interventions are effective at improving glycaemic control and reducing outpatient appointments and emergency inpatient admissions, leading to a significant reduction in healthcare costs [30,31,32]. Psychosocial interventions are diverse, integrating psychological, behavioural and environmental aspects of diabetes to improve mental health outcomes associated with the diagnosis and management of diabetes alongside the lifestyle and behaviour changes required.

To develop effective interventions for individuals with elevated HbA_{1c}, we need to understand what works. To date, the literature has focused on the psychological impact of diabetes, with the majority of existing systematic reviews exploring the impact of psychosocial interventions on depressive symptoms, diabetes-related distress and quality of life in people living with diabetes [33,34,35]. Whilst some reviews have explored the impact of psychosocial interventions on general diabetes management and physical health outcomes [36,37,38], the impact of diabetes on healthcare utilisation and what interventions are effective to reduce utilisation and pressure on services has been overlooked. Therefore, the present review will address the current gap in the literature and exclusively focus on hospital admission reduction.

The aim of the review was to identify all eligible psychosocial interventions targeted at reducing diabetes-related hospital admissions among individuals with elevated HbA_{1c} (defined as individuals with an HbA_{1c} level of >58 mmol/mol (7.5%)). This adds to the current literature on the impact of interventions on diabetes self-management and addresses a gap in the literature by looking at interventions targeted at individuals with elevated HbA_{1c} and their effectiveness with regard to diabetes-related hospital admissions. Whilst there is no universal consensus within the literature to identify an HbA_{1c} threshold indicating uncontrolled diabetes, for the purposes of this review, the level of 58 mmol/mol (7.5%) and above was used to define elevated HbA_{1c}, as previously stated by National Institute for Health and Care Excellence (NICE; 2015) and Buckinghamshire Healthcare NHS Trust (2017).

Method

Protocol and registration

This study was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses

(PRISMA) guidelines [39]. A protocol for this systematic review was published and can be accessed on PROSPERO (CRD42019133456; available at: https://www.crd.york.ac.uk/prosperto/display_record.php?ID=CRD42019133456).

Eligibility criteria

Articles meeting the following eligibility criteria were included:

1. Studies published in the English language in a peer-reviewed journal with a quantitative methodology. No limitations were applied to year of publication to identify as many potentially eligible studies as possible.
2. Studies that included a psychosocial intervention aimed at improving outcomes in people with diabetes were included. Psychosocial interventions were defined as any intervention emphasising psychological or social factors as opposed to biological factors [40]. Interventions targeting multiple chronic conditions were excluded as the focus of the review was to identify interventions targeting individuals with elevated HbA_{1c} levels specifically.
3. Studies evaluating the effectiveness of the intervention on individuals diagnosed with either type 1 or type 2 diabetes with elevated HbA_{1c} were included. In this review elevated levels were defined as an HbA_{1c} level of >58 mmol/mol (7.5%) as individuals diagnosed with diabetes are recommended to control HbA_{1c} levels between 48 and 53 mmol/mol (6.5–7.0%) to avoid complications [26]. Participants of all ages were included.
4. Studies reporting diabetes-related hospital admissions, e.g. diabetic ketoacidosis, as either the primary or secondary outcome were included.

Information sources

Six electronic databases (MEDLINE, PsychINFO, CINAHL, AMED, Embase and Scopus) were used to identify eligible studies. Searches were conducted in November 2018 and updated in February 2019. Citations of studies where full texts were screened were hand-searched to identify additional studies and study authors were contacted to request a copy of full text when not available and to identify any additional relevant studies. An expert in the field of diabetic ketoacidosis was contacted to identify further possible studies. RefWorks was used to organize the results from each search engine and to remove duplicates.

Search terms

The search strategy was developed using the 'PICO' (Population, Intervention, Comparison and Outcomes) approach. Population terms aimed to identify all references

related to individuals with either type 1 or type 2 diabetes and elevated HbA_{1c} (diabetes or 'diabetes mellitus' or 'poor manage* diabetes' or 'poor glycaemic control' or diabet* or diabetic). Intervention search terms related to intervention delivery and aimed to capture psychosocial interventions ('psycho* intervention' or psychother* or intervention* or 'digital intervention' or telemedicine or 'psychosocial intervention' or psychoeducation or 'motivation* interview' or counselling or 'cognitive behavioural therapy' or 'group therapy' or self-help) and outcome terms related to diabetes-related hospital admissions ('hospital admission' or hospitalization or ketoacidosis or acidosis or DKA or 'diabetic ketoacidosis').

No limitations were applied to databases during the search to ensure as many eligible studies as possible were identified. Studies were then excluded according to eligibility criteria throughout the screening process.

Study selection

On completion of electronic database searches, papers were exported to RefWorks from all databases. Once duplicates were removed, an eligibility assessment was performed, which involved the screening of titles and abstracts against the inclusion criteria (Appendix S1). Studies that were retained after screening of titles and abstracts were fully screened by two independent reviewers (H.M., S.S.) and any discrepancies were discussed and resolved with a third independent reviewer (S.C.). The process is summarized in the PRISMA flow diagram (Fig.1).

Data collection process and data items

Data extraction was undertaken for all studies that met the inclusion criteria using a structured data extraction form designed for the review (Appendix S2), adapted from the Cochrane Collaboration data collection form (Appendix S3). The data extraction sheet was pilot-tested on two randomly selected studies and refined accordingly. Two reviewers (H.M., S.S.) independently extracted data from each full paper, with any discrepancies resolved by discussion and consensus. Where information was not available, study authors were contacted for clarification. The extracted information captured details on the study population, intervention and outcomes. Data extracted from studies using the data extraction form was summarized and tabulated to identify key characteristics of each study (Table 1).

Risk of bias

Studies were evaluated using the Effective Public Health Practice Project Quality Assessment Tool [10] to assess internal and external validity by rating risk of bias for each study. Each study was assessed on: selection bias, study

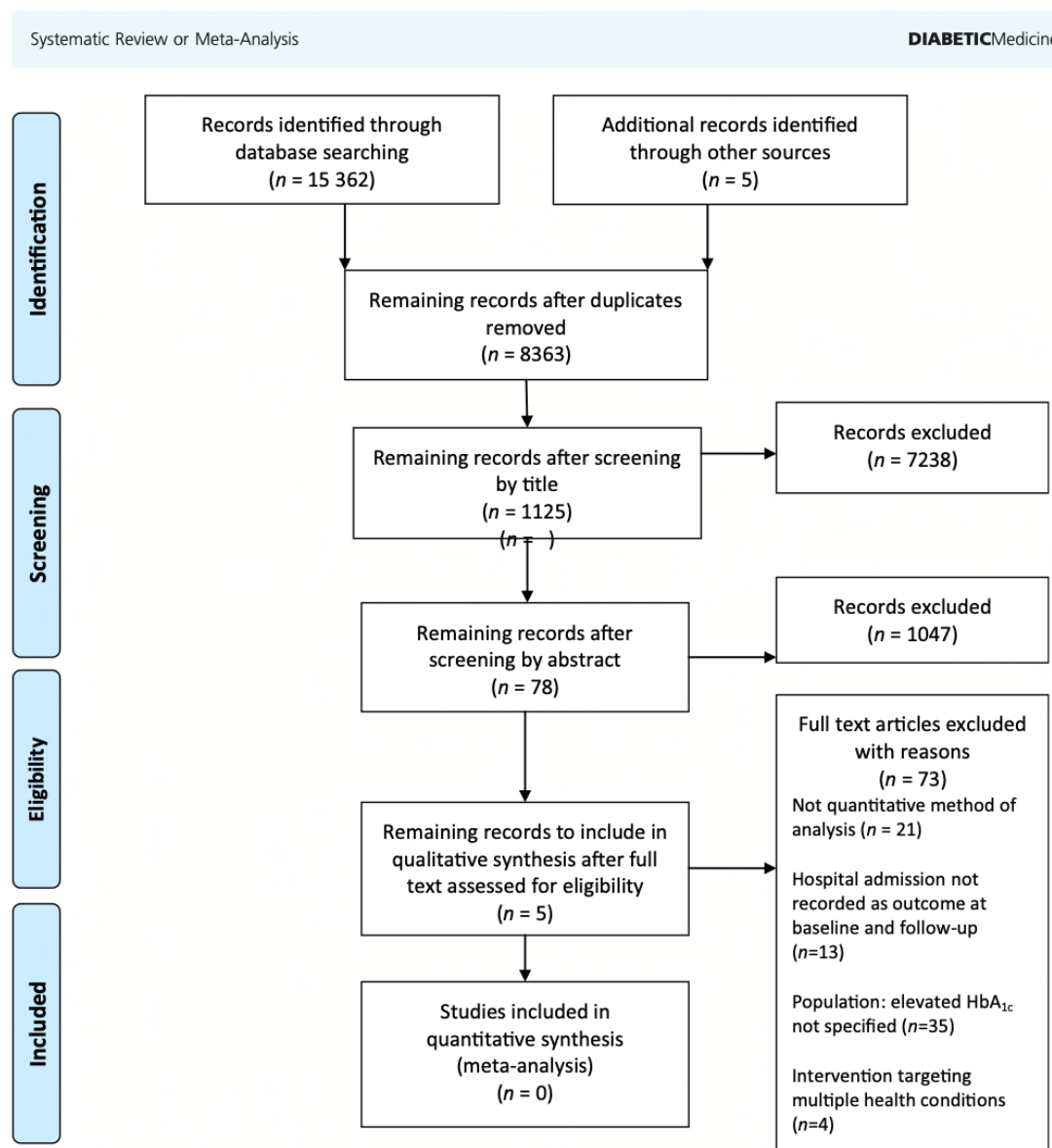


FIGURE 1 PRISMA flow diagram of studies that were screened, excluded (with reasons) and included. [Colour figure can be viewed at wileyonlinelibrary.com]

design, confounders, blinding, data collection methods, withdrawals and drop-outs, intervention integrity and analyses. Papers were assessed independently by two reviewers (H.M. and S.S.) and discrepancies were discussed and resolved by a third reviewer (S.C.). In line with the tool, studies were rated as having strong, moderate or weak methodological quality following assessment of bias. The methodological quality overall and in each domain is summarized in Table 2 for individual studies and will be discussed further throughout the review in relation to the effectiveness of interventions.

Summary measures

The outcome of interest for this systematic review is diabetes-related hospital admissions. The principal summary measure used was difference in diabetes-related hospital admissions before and after the intervention. The time interval between pre- and post-intervention measures ranged from 5 to 18 months across studies. Odds ratios and confidence intervals (CIs) are reported with other measures in Table 1, however, for the purpose of this review only the main outcome will be discussed in detail.

Table 1 Characteristics of included studies

Study (year), country	Study design	Participants	Intervention	Control or comparison	Measures	Results	Effect Size	Global Quality Score
Adepoju et al. (2014), USA [1]	Retrospective cohort analysis using secondary data from recently conducted RCT	N = 376; age 18+ years (mean age 57.56 years), type 2 diabetes, mean HbA _{1c} 77 mmol/mol (9.2%)	6-week CDSMP involving weekly 2.5-h training sessions on diabetes self-management (n=101). 24-month follow-up	PDA handheld device (n=81), usual care (n=95), and combined PDA and CDSMP (n=99)	HbA _{1c} levels, acute hospital events relating to diabetes, length of stay for each acute event, healthcare financing and reimbursement, comorbidities, pharmaceutical data, sociodemographics, technological experiences, self-reported health-related quality of life, summary of diabetes self-care activities, pain and fatigue measures, physical activity measures	Participants enrolled in the CDSMP-only arm had a statistically significant lower odds of diabetes-related hospitalisation ($P \leq 0.01$) and also had a statistically significant lower risk/shorter time-to-hospitalisation ($P \leq 0.01$) when compared to participants in the control arm	Diabetes-related admissions odds ratio 0.12 (CI 0.03–0.43) Diabetes-related emergency department visits odds ratio 0.05 (CI 0.01–0.21)	Weak
Ellis et al. (2005), USA [11]	RCT	N = 127; 10–17 years (mean 13.25 years), type 1 diabetes, mean HbA _{1c} 110 mmol/mol (11.3%)	MST delivered 2–3 times per week for 6 months (n=64). 24-month follow-up.	Control group of standard medical care (n=63)	Hospital utilisation data, 24-h recall interview, frequency of blood testing, HbA _{1c}	There was a significant reduction in inpatient admissions for adolescents receiving MST ($P \leq 0.05$). The intervention group also had significantly fewer diabetic ketoacidosis admissions relative to baseline frequency at 6-month ($P \leq 0.01$), 12-month ($P \leq 0.05$), 18-month ($P \leq 0.05$) and 24-month follow ups ($P \leq 0.05$).	Inpatient admissions: $d = 0.65$ (medium)	Moderate
Wagner et al. (2017), USA [45]	Retrospective analysis	N = 25; mean age 15.8 years, type 1 and type 2 diabetes, mean HbA _{1c} 110 mmol/mol (12.2%)	Personalized text messages tailored to individual needs. 12-month follow-up	None	Number of diabetic ketoacidosis admissions, HbA _{1c} , number of hospital admissions, number of days admitted, number of emergency department visits. Measured year prior to intervention onset and year subsequent to onset.	No significant difference between number of emergency department visits during year prior to NICH onset and year subsequent to NICH onset ($P = 0.57$), but significant decrease in diabetic ketoacidosis episodes from the year prior to NICH onset to the year during intervention ($P < 0.01$).	Number of admissions: $d = 0.31$ (small), number of emergency department visits: $d = 0.17$ (small), number of visits in diabetic ketoacidosis: $d = 0.56$ (medium)	Weak
Moran et al. (1991), UK [29]	Non-randomized control trial	N = 22; age 6–18 years (mean age 13.7 years), type 1 diabetes, HbA _{1c} > 119 mmol/mol (13.0%) no means stated.	45-minute Psychotherapy sessions delivered 3–5 times weekly for an average of 15 weeks (n= 11).	Control group (n= 11) received usual medical care and diabetes education	M value, HbA _{1c} , number of readmissions to hospital	Significant reduction in hospital admissions solely for diabetic imbalance ($P \leq 0.05$) in intervention group.	$d = 0.83$ (large)	Moderate

Table 1 (Continued)

Study (year), country	Study design	Participants	Intervention	Control or comparison	Measures	Results	Effect Size	Global Quality Score
Nunn <i>et al.</i> (2006), Australia [31]	RCT	N = 123; age 3+ years (mean age 11.9 years), type 1 diabetes, mean HbA _{1c} 66 mmol/mol (8.2%)	12 month follow-up. Bi-monthly phone calls including management advice, psychological support and education. 8 month follow-up	Control group received usual care and in addition could contact the diabetes team by phone	HbA _{1c} level, admission rates, Test of Diabetes Knowledge, compliance, Strengths and Difficulties Questionnaire, Indicators of Social and Family Functioning	Additional phone contact did not significantly improve rate of hospital admissions (number of admissions $P = 0.57$ and admission days $P = 0.50$)	Not sufficient information to calculate	Strong

CDSMP, Chronic Disease Self-Management Programme; diabetic ketoacidosis, diabetic ketoacidosis; MST, multisystemic therapy; NICHD, Novel Interventions In Children's Healthcare; PDA, Personal Digital Assistant; RCT, randomized controlled trial.

Cohen's *d* was used to interpret effect sizes of results reported within the reviewed studies. Effect sizes of 0.20 were considered to be small, while effect sizes of approximately 0.50 were considered to be medium. Effect sizes of approximately 0.80 or above were considered to be large [42].

Synthesis of results

Because there was considerable heterogeneity in study design, methodology and statistical approaches, a meta-analysis was not possible. A narrative synthesis was conducted, following the guidance on the conduct of narrative synthesis in systematic reviews [43].

Results

Study selection

The study selection process and reasons for exclusion were documented using a PRISMA flow chart (Fig. 1). Characteristics across studies and interventions are described below, and the effectiveness of these interventions is summarized, taking into account methodological quality.

Study characteristics

Table 1 shows the main characteristics of each study included in the review. Study designs varied and included two randomized controlled trials (RCTs) [44,45], one non-RCT [46], and two retrospective analyses of existing data from a previous RCT [47] and a previous intervention [48]. Across studies, 673 participants were included, with sample sizes ranging from 22 to 376. Four of the five included studies had a female sample bias [44,46,47,48], meaning there was an overall female sample bias across studies. Only one study included adult participants [47], with the majority of studies including young people with diabetes. Range and mean of participant ages could not be calculated because of missing data. The studies included participants with both type 1 and type 2 diabetes, although only two included individuals with type 2 diabetes [47,48]. Ethnicity was only documented in three of the included studies. In two of these, white participants accounted for between 64% [47] and 100% [45] of the sample. Ellis *et al.* [44] reported that 62% of participants were African American, but no information on country of origin is stated.

The included studies reported a number of outcomes and the effectiveness of interventions on these outcomes; however, as the present review focuses specifically on the impact on diabetes-related hospital admissions, only the effectiveness for this outcome is discussed. All studies assessed the effectiveness of an intervention on diabetes-related hospital admissions as either a primary or secondary outcome, and results of individual studies evaluating the effectiveness are

presented in Table 1, with statistics reported to two decimal places (for full data see original papers cited). Diabetes-related hospital admissions were recorded and measured using electronic patient records [44,47,48] and used the International Classification of Diseases, Ninth Revision – Clinical Modification codes to capture hospital admissions specifically related to diabetes. Two of the studies do not report how diabetes-related hospital admissions were recorded [45,46].

Intervention characteristics

The rationale for interventions across studies was to improve outcomes by engaging individuals in diabetes self-management. A range of psychosocial interventions was used across the included studies, including structured education, some form of psychotherapy and personalised support delivered via telephone.

Two psychological interventions [44,46] explored the impact of individual psychotherapy on diabetes-related hospital admissions. Moran *et al.* [46] delivered individual psychotherapy in hospital alongside medical treatment which involved a detailed formulation of the child's condition from a combined endocrinological and psychological viewpoint. Ellis *et al.* [44] delivered multisystemic therapy at home to adolescents and their families, targeting adherence-related problems.

Two of the interventions included in this review were telephone-based. Nunn *et al.* [45] investigated the impact of bi-monthly telephone calls on diabetes outcomes among individuals with elevated HbA_{1c} levels. Telephone calls lasted between 15 and 30 minutes and covered a range of topics including management advice, psychological support and education. Parents were also included in discussions if they usually made the treatment decisions at home. Wagner *et al.* [48] explored the effectiveness of a personalized text-messaging intervention delivered by Novel Interventions In Children's Healthcare (NICH) interventionists. Text messages were personalized and tailored to individual needs, providing reinforcement for diabetes management, skills coaching, and assistance with problem-solving.

One study involved a structured education course [47], which was delivered face to face over a number of weeks in a classroom setting and delivered by trained coaches who had received standardized training in diabetes self-management. Sessions were based on an educational model developed by Stanford University which focused on equipping individuals to be proactive in managing their chronic condition, however, it is not clear from the study what specific topics the education course covered.

The time interval between measurements of diabetes-related hospital admissions varied across studies. Pre-intervention measures ranged from 0 to 12 months and follow-up post-intervention measurements were between 5 and 24 months.

Effectiveness of interventions by intervention type

The effectiveness of these interventions at reducing diabetes-related hospital admissions among individuals with elevated HbA_{1c} is presented in Table 1. Of the five interventions identified, four demonstrated a significant reduction in diabetes-related hospital admissions [1,29,45].

Results indicated moderate evidence for the effectiveness of individual psychotherapy at reducing diabetes-related hospital admissions in individuals with elevated HbA_{1c} [11,44]. Ellis *et al.* [44] found that those receiving multisystemic therapy had significantly fewer admissions than control participants, with a medium effect size ($P \leq 0.05$, $d = 0.65$). This effect was maintained over the 24-month follow-up period. Moran *et al.* [46] also reported a reduction in hospital admissions related to diabetes among children and adolescents receiving psychotherapy, with a large effect size ($P \leq 0.05$, $d = 0.83$). Both studies had a strong study design with little bias across domains, however, overall had a moderate global rating for quality (Table 2), providing moderate evidence for the effectiveness of interventions involving individual psychotherapy.

Evidence in support of telephone-based interventions was weak. Wagner *et al.* [48] reported a significant decrease in the number of ketoacidosis episodes as a result of a text-messaging intervention ($P \leq 0.01$, $d = 0.56$), despite no significant difference in emergency department visits ($P = 0.57$, $d = 0.17$). However, this was a retrospective study design with a small sample and data were only for individuals with available text message data meeting criteria so may not be generalizable to other populations. There was also a risk of confounders and blinding bias, therefore, evidence to support the effectiveness of text-messaging interventions at reducing diabetes-related hospital admissions is weak. Furthermore, there was strong evidence to suggest bi-monthly telephone calls are ineffective at reducing diabetes-related hospital admissions among individuals with elevated HbA_{1c}. Nunn *et al.* [45] reported an increase in admissions in both intervention and control groups with a small effect size ($P = 0.57$, $d = 0.31$).

Adepoju *et al.* [47] reported that individuals in the intervention group receiving structured education on diabetes management had significantly lower odds of healthcare utilization ($P \leq 0.05$) when compared to participants in other arms, however, the methodological quality was poor because of a lack of clarity on data collection methods and measures and risk of confounder, blinding and withdrawal bias. Despite statistically significant results, therefore, we cannot confidently draw conclusions regarding the effectiveness of this intervention.

Methodological quality

The methodological quality of the included studies was assessed using the Effective Public Health Practice Project

Table 2 Risk of bias according to Effective Public Health Practice Project Quality Assessment Tool (1998)

Author	Selection bias rating	Study design rating	Confounders rating	Blinding rating	Data collection method rating	Withdrawals and drop-outs rating	Global rating
Adepoju <i>et al.</i> (2014) [48]	Strong	Strong	Moderate	Weak	Weak	Weak	Weak
Ellis <i>et al.</i> (2005) [44]	Moderate	Strong	Strong	Weak	Strong	Strong	Moderate
Wagner <i>et al.</i> (2017) [47]	Strong	Weak	Weak	Weak	Strong	Strong	Weak
Moran <i>et al.</i> (1991) [46]	Strong	Strong	Strong	Weak	Strong	Moderate	Moderate
Nunn <i>et al.</i> (2006) [45]	Strong	Strong	Strong	Moderate	Strong	Strong	Strong

Quality Assessment Tool [41] for quality assessment and is summarized in Table 2.

Selection bias across studies was generally low, therefore, studies were likely to be representative of the target population, and study design was also rated as strong, with the exception of one retrospective analysis [48]. In most cases, data collection tools were shown to be valid and reliable [44,45,46,48], however, it was unclear in one study [47] as data collection methods and measures used were not stated.

It was clear in three studies that there were no important differences between groups prior to the intervention [44,45,46], however, in the remaining studies there is a risk of bias as both differences between groups, and whether confounders were controlled if differences were present were unclear. There was also a risk of blinding bias across studies as two studies reported that outcome assessors were aware of the intervention or exposure status of participants [45,46], and blinding status in the remaining studies was unclear.

Three studies [44,45,48] reported withdrawals and drop-outs in terms of numbers and the reasons. For the remaining two studies withdrawals and reasons were not reported, therefore, there is a risk of bias across studies when considering withdrawals and drop-outs.

Overall, the risk of bias across studies was moderate. The main methodological flaw was risk of bias because of a lack of blinding or not enough information about blinding in individual studies. None of the included studies received a 'strong' rating for blinding (Table 2) and this has an impact on the conclusions that can be drawn from the results of the present review.

Discussion

The aim of the present systematic review was to explore the effectiveness of psychosocial interventions on diabetes-related hospital admissions among individuals with elevated HbA_{1c}. To our knowledge this is the first study to address what might work better in this higher-risk group in relation to reducing the burden on healthcare. Results from this systematic review provide moderate evidence for the effectiveness of psychosocial interventions at reducing diabetes-related hospital admissions in the high-risk population. Five

quantitative studies met the inclusion criteria and four of these reported significant improvements in hospital admissions related to diabetes, with effect sizes ranging from small to large and mixed methodological quality.

Results provided moderate evidence to support the effectiveness of interventions involving individual psychotherapy to reduce diabetes-related hospital admissions among adolescents with elevated HbA_{1c} with medium to large effect sizes [44,46]. Interventions delivering individual psychotherapy [44,46] should be considered for such individuals to reduce the risk of complications and hospital admissions related to diabetes. Such interventions are costly as they involve intensive interventions and therapists have small caseloads, however, Ellis *et al.* [44] reported that whilst providing multisystemic therapy was costly (£5,380 per youth), there was still a substantial cost offset due to reductions in diabetic ketoacidosis admissions, therefore, there is the potential for overall savings despite initial costs incurred.

The effectiveness of other interventions included in this review is less clear. Text-messaging-based interventions and structured education programmes targeted at individuals with elevated HbA_{1c} levels do have potential to reduce diabetes-related hospital admissions and as these interventions are less resource-intensive, they are likely to be more cost-effective [47,48]. Adepoju *et al.* [47] found that participants receiving the self-management programme had significantly lower odds of diabetes-related hospital admissions, which supports previous research [49], however, due to methodological flaws the generalizability of results cannot be guaranteed, and further research with strong methodological quality is needed.

Support for the effectiveness of telephone-based interventions was also inconclusive. A personalized text-messaging intervention with tailored messages providing reinforcement, skills coaching and problem-solving was reported to significantly reduce diabetic ketoacidosis episodes and hospitalization with a medium effect size [48], however, this was a retrospective analysis and due to underpowered analyses and lack of a control group it is not possible to determine the effectiveness of text-messaging-based interventions on reducing diabetes-related hospital admissions. Furthermore, there

was strong evidence to suggest that bi-monthly telephone calls offering management advice, psychological support and education does not improve the rate of diabetes-related hospital admissions [45], therefore, more research is needed to determine the effectiveness of telephone-based interventions in this population.

Recommendations drawn from this review must consider the scientific quality of methods used in the field as methodological flaws were identified in the design of many studies included in this review (Table 2). The most common methodological flaw was found to be issues with blinding, however, there were methodological weaknesses identified in all studies therefore further research is needed in this area to improve knowledge and understanding of the effectiveness of psychosocial interventions at reducing diabetes-related hospital admissions in individuals with elevated HbA_{1c}.

Limitations at review level should also be acknowledged. Because of the specific focus on diabetes-related hospital admissions as an outcome, only five studies met the inclusion criteria (Figure 1), therefore, the sample of studies reviewed was small and further research is needed. This was considered as a potential issue when defining the search terms, and a broad study population including all ages and individuals diagnosed with both type 1 and type 2 diabetes was chosen, with the aim of capturing as many relevant studies as possible to assess the effectiveness of current interventions.

As this research reviewed interventions aimed at both type 1 and type 2 diabetes, it is important to consider that intervention needs are likely to differ because of differences in the aetiology of disease, and in the management and psychological needs of people living with the conditions. Such differences must be considered when designing interventions to reduce diabetes-related hospital admissions in order to address specific needs relevant to type 1 or type 2 diabetes.

Furthermore, there is a lack of explicit theoretical rationale for interventions included in this review, which is important to consider as previous research suggests theoretically based interventions may be more beneficial [36].

Despite the small number of final papers included, focusing on diabetes related hospital admissions as an outcome was required for the purpose of this review; however, further research is required in order to draw significant conclusions. Results from this study may also be subject to publication bias as, although reference lists were hand-searched, there was no extensive review of grey literature. Potential papers may also have been missed as a result of excluding papers that were not published in the English language.

Only one of the five included studies [47] included adults in the study sample, therefore, results cannot be generalized to the general population of individuals with elevated HbA_{1c} values. Most studies only included participants with type 1 diabetes, therefore, results are unlikely to be applicable to individuals with type 2 diabetes. Future research should

therefore target adults diagnosed with type 2 diabetes and are identified as having elevated HbA_{1c}.

The majority of individuals living with diabetes are diagnosed with type 2 diabetes and are adults [1], therefore, without addressing this key population gap the ability to draw conclusions from research regarding the effectiveness of interventions is limited.

Furthermore, whilst all the studies were conducted in western countries (UK, USA and Australia), only one of the studies included in this review was conducted in the UK, therefore, generalisability to the UK population and health-care system should be considered and further research conducted in the UK is needed.

In conclusion, this systematic review provides an evaluation of current intervention research in this area and has identified four psychosocial interventions that have reduced diabetes-related hospital admissions among individuals with elevated HbA_{1c}. In particular, there is good evidence that interventions involving psychotherapy for the high-risk population have the potential to reduce the risk of complications, hospital admissions and related costs. Designing and testing psychosocial interventions targeting individuals with elevated HbA_{1c} should be considered, but the results of this review indicate the need for further research with methodological rigour to build on existing evidence.

As found previously [36], this review highlights the need for psychosocial interventions to be guided by principles of psychological theory.

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Competing interests

None declared.

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APPENDIX M: Pilot survey testing email and responses**Email sent to participants to test survey**

Hannah Moulson (Student)
Tue 01/12/2020 18:52

Thank you for agreeing to test and review the **survey** for the above research which can be accessed via the link below.

https://uwe.eu.qualtrics.com/jfe/form/SV_5p7zCCDnRYMPC2V

Please provide your response to the questions below and any other comments.

- Were the instructions and questions were easy to understand?
- Do you feel the questions are appropriate for the purpose of the study?
- Was there anything we didn't ask you that you feel we should have?

Please include any other comments you may have if not covered by the above questions.

Thanks for your time

Kind regards
Hannah Moulson
(Trainee Health Psychologist)

Responses (names and contact details removed to ensure confidentiality)

Fri 04/12/2020 09:42
Hi Hannah,

All looks great. Clear and easy to understand. I did this from my phone also and it worked nicely.

Thanks

Get [Outlook for iOS](#)

Wed 02/12/2020 16:49

Hi Hannah

I have just tested your research on my mobile and all worked well, I didn't spot any errors or mistakes and I could see everything on my screen fine. It was just simply being able to read it and select an answer and scroll on - I have an iPhone! My only point for consideration is maybe check it out for people who may have sight problems and might use a mobile but with large text to ensure they can complete it ok

Many thanks

Get [Outlook for iOS](#)

Wed 02/12/2020 09:17

Hi Hannah

It was really easy to do and quick (I think it took me 10 mins)

The only thing I think people might get confused about is at the beginning: Could you maybe add a few more examples or a list of exclusions? I think a lot of people might not take part assuming that they're not suitable

Hope that helps

Sat 06/12/2020 19:23

Hi Hannah

Instructions were easy to understand

Questions appropriate in my opinion

No other suggestions or comments I thought of

Thanks