

Volume One: Research Component

Diabetes:

The benefits of mindfulness interventions and the
role of cognitive flexibility.

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Overview

This thesis was submitted as part of the Doctorate in Clinical Psychology at the School of Psychology, University of Birmingham. It comprises of two volumes. The first volume is the research component and includes an empirical study and a review of the literature. The second volume is the clinical component and includes five clinical practice reports.

Volume I: Research Component

Volume I of this thesis consists of a systematic literature review and an empirical paper. The literature review component evaluates research on the use of mindfulness interventions with people who have diabetes. Living with diabetes has both a psychological and physical impact on a person's life. A variety of different mindfulness interventions and their benefits to both physical and psychological wellbeing are discussed. The empirical paper presents a cross-sectional study that investigates if the relationships between diabetes related distress and depression is mediated by cognitive flexibility.

Volume II: Clinical Component

Volume II of this thesis consists of five Clinical Practice Reports (CPR). CPR 1 presents a cognitive behavioural and psychodynamic case formulation for Ravi, a service user at a men's medium secure forensic service. Ravi presented with psychotic depression following the murder of his partner. CPR 2 is a service related research project that

evaluates the provision of weekly community meetings at men's medium secure forensic service. CPR 3 is a case study of Susan, who was seen in a multidisciplinary community pain service as she was experiencing chronic musculoskeletal pain and depression. The report presents an assessment of Susan's difficulties, a cognitive behavioural formulation, the multidisciplinary intervention used and an evaluation. CPR 4 reports a single case experimental design used to evaluate the effectiveness of an intervention used with Jane, an older adult who presented with behaviours that challenge. Jane was a service user in an organic older adult's inpatient service. CPR 5 was an oral case study. An abstract of the presentation is presented. This was a case study of Jasmine who was seen by the psychology team at a community learning disabilities service. Jasmine was referred to the team for an assessment and possible intervention for her anxiety around leaving home independently.

Dedication

I would like to dedicate this thesis to the loving memory of my Baa (Grandma) who passed away during the first year of my doctorate. I know that this would have been a proud moment for you. Your blessings and memories have been a great source of strength and inspiration in writing this thesis and completing my doctorate.

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There are a number of people I would like to thank. Mum, Dad, Rishi, Nana, Nani and Bapa, thank you for believing in me, supporting me and encouraging me. You along with Baa have helped me to achieve something at one stage I would have never imagined I was capable of.

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LITERATURE REVIEW

Mindfulness as an intervention in the management of diabetes: A systematic literature review

Abstract

Purpose – The purpose of this systematic review is to evaluate research on the benefits of mindfulness as an effective intervention for the management of both the psychological and physical aspects of diabetes and diabetes related conditions.

Methods – A systematic search was carried out on electronic journal databases for published empirical studies that looked at the use of mindfulness and mindfulness-based interventions with people who have diabetes. Literature searches identified 10 studies that investigated the use of mindfulness and mindfulness based interventions with people who have diabetes. The quality of the 10 studies was assessed using an adapted form of the quality framework outlined in Downs & Black (1998).

Results - Based on the literature reviewed there are some studies advocating benefits of mindfulness interventions for helping with both the physical and psychological aspects of having diabetes and diabetes related health conditions.

Conclusions – Whilst the roots of mindfulness are grounded in Buddhist philosophy the research focus on the use of mindfulness is still fairly recent. In some types of mindfulness interventions there has only been one study focused on people with diabetes published. Therefore more research is still needed. However, the initial findings do seem promising. The quality of the research reviewed is discussed and recommendations for future studies are made.

Introduction

There is an increasing prevalence of diabetes in the global population. In 2010, 285 million people had been diagnosed with diabetes and this figure is expected to rise to 439 million by 2030 (Shaw, Sicree & Zimmet, 2010). Diabetes is a metabolic disorder characterised by increased levels of blood glucose if left untreated. Symptoms of undiagnosed diabetes include hyperglycaemia passing urine more frequently than usual (particularly at night), increased thirst, extreme tiredness, unexplained weight loss, slow healing cuts and wounds and blurred vision (Choices, 2013). The two most common types of diabetes are type 1 and type 2. Type 1 diabetes usually develops before the age of 40 and in most cases in adolescence. In type 1 diabetes the pancreas does not produce any insulin. In type 2 diabetes the pancreas either does not produce enough insulin or the body has become resistant to its own insulin (Choices, 2013).

Diabetes is a chronic condition that relies on patient self-management as part of treatment. Type 1 diabetes is normally managed by self-administering insulin, which is usually injected at various times during the day. For type 2 diabetes management is first and foremost dietary, then oral tablets and if glycaemic control still cannot be achieved this way, then insulin can be prescribed. For both type 1 and type 2 diabetes self-management also includes regular blood glucose monitoring.

People with diabetes also often experience stigma, which has a negative impact on psychological well-being. The experience of stigma often stems from attitudes of blame, feelings of fear and disgust from others. These may then lead to a person with diabetes feeling judged, rejected and discriminated. Consequently, this leads to a person with

diabetes feeling distressed, having poorer psychological well-being and neglecting their self-care (Schabert, Browne, Mosely, & Speight, 2013). People with diabetes often have negative experiences when injecting insulin in public places. Tak-Ying Shiu, Kwan, & Wong (2003) suggest people with diabetes relate these negative experiences to the general public's lack of awareness of diabetes and the way in which it is managed. As a result of this people with diabetes then perceive the public as mistaking them for intravenous drug addicts or holding the belief that people have diabetes as a result of over-indulgence with food.

The prognosis of diabetes depends on how well a person adheres to their self-management regime. Poor self-management is influenced by a host of psychological factors including not accepting diagnosis, depression and believing self-management is too difficult (Naude, 2007).

Diabetes is related to serious complications that affect a number of organs and systems in the body. These include nephropathy, retinopathy and neuropathy as well as cardiovascular disease including stroke and heart disease (Shaw & Cummings, 2012). In addition to poor self-management there is a strong genetic component in diabetes complications (Doria, 2010). The diagnosis of diabetes related complications in patients who have strived to maintain optimal glycaemic control tends to reinforce vulnerability, a sense of lack of control over the future and hopelessness. For patients who have poor diabetes self-management, the diagnosis of complications associated with diabetes can bring out feelings of intense guilt (Harris, 2003).

One meta-analysis suggested that people with type 1 diabetes experience cognitive difficulties. More specifically difficulties were reported in processing speed and cognitive flexibility (Brands, Biessels, De Haan, Kappelle, & Kessels, 2005). Another longitudinal study that compared middle-aged people with type 2 diabetes to middle aged people without diabetes suggested that the people with diabetes showed greater decline on global cognitive function and cognitive flexibility tasks (Nooyens, Baan, Spijkerman, & Verschuren, 2010).

In addition to physical complications and cognitive difficulties, diabetes is also associated with anxiety (Li et al., 2008; Penckofer, Ferrans, Velsor-Friedrich, & Savoy, 2007), feelings of anger (Penckofer et al., 2007) and depression (Egede & Ellis, 2010). Research has shown that as well as depression having a negative impact on the quality of life of people with diabetes, it is also related to poorer glycaemic control, worse cardiovascular outcomes and increased health care consumption. A meta-analysis has shown that in comparison to people who do not have diabetes, people with type 2 diabetes have a 24% increased risk of developing depression (Nouwen et al., 2010). Compared to people with diabetes and low levels of depression, people with diabetes and moderate or high levels of depression, are significantly less likely to adhere to dietary recommendations and oral medication regimes (Ciechanowski, Katon, & Russo, 2000). Ciechanowski, Katon, Russo, & Hirsch (2003) suggest that due to association between the clinical aspects of diabetes care such as symptom reporting and adherence to self-care plans it is important to be able to recognise symptoms of depression in people with diabetes.

Whilst there is still some debate in the aetiology of depression in people with diabetes it is likely that both biological and psychological factors play a role (Ali, Stone, Peters, Davies, & Khunti, 2006; Barnard, Skinner, & Peveler, 2006). Depression has been found to be related to poor glycaemic control, which is a major factor that leads to diabetes related complications (Lustman et al., 2000). Depression is also common in people with diabetes comorbidity (de Groot, Anderson, Freedland, Clouse, & Lustman, 2001; Pouwer et al., 2003) and elevated levels of diabetes-related stress (Pouwer et al., 2005). One study has also suggested that people with type 2 diabetes who reported increased levels of depression also had negative appraisals about insulin therapy. These negative appraisals seemed to be around feeling like a failure and struggling with the burden of managing insulin injections (Makine et al., 2009). It can be argued that the burden of insulin management is also related to diabetes related distress. On this basis it would seem that helping people with diabetes to effectively manage diabetes related distress would reduce their risk of developing depression.

There is growing evidence to show the benefits of mindfulness and mindfulness based therapies as an intervention for management of general stress in both clinical and non-clinical populations (Brantley, 2005; Kabat-Zinn, 1982; Miller, Fletcher, & Kabat-Zinn, 1995); and depression (Teasdale & Segal, 2007; Teasdale et al., 2000). The practice of mindfulness has been shown to help people with both health related difficulties and general wellbeing. Improvements have been observed in quality of life (QOL), depression, anxiety, coping style and distress as well as physical well-being, sensory pain, physical impairment, and biological measures of health (Grossman, Niemann, Schmidt, & Walach, 2004).

Mindfulness is a term derived from the Pali word 'sati', which means awareness, attention and remembering (Bishop et al., 2004; Gunaratana & Gunaratana, 2011). Mindfulness aims to help people to learn to pay attention to the things they do and embrace the full experience of what they are doing without judging (Bishop et al., 2004). A number of psychological interventions have grown out of the practice and philosophy of mindfulness. One of the first interventions developed on these principles was Mindfulness Based Stress Reduction (MBSR, Kabat-Zinn, 1990). MBSR is typically delivered as an eight-week group programme. The programme focuses on body and meditation practices and helps participants to increase openness and awareness to all internal and external experiences. This state of increased awareness and openness helps an individual to be more in tune with their experiences and respond more proactively rather than reactively. Another intervention rooted in mindfulness philosophy is Mindfulness Based Cognitive Therapy (MBCT, Teasdale, Segal, & Williams, 1995). MBCT combines aspects of cognitive therapy with mindfulness practices and helps an individual to become more aware of their thoughts in a non-judgmental manner. In this approach individuals are encouraged to see their thoughts as passing events as opposed to facts (Ma & Teasdale, 2004; Teasdale et al., 2000). Similar to MBCT, mindfulness also forms a large component of other third wave cognitive behavioural approaches including Acceptance and Commitment Therapy (ACT, Hayes, Luoma, Bond, Masuda, & Lillis, 2006). Across all of the interventions that are grounded in mindfulness, Mindfulness Meditation (MM) is a central and consistent component.

In addition to the management of stress, the potential of mindfulness to improve the health and wellbeing of people living with diabetes and diabetes related conditions has

been the focus of a number of recent studies (e.g. Gregg, Callaghan, Hayes, & Glenn-Lawson, 2007; Miller, Kristeller, Headings, Nagaraja, & Miser, 2012; Rosenzweig et al., 2007). Research has examined the potential for mindfulness-based interventions to be effective, safe and practical methods for the management and adjustment to a diagnosis of diabetes and its related complications (Selfridge, 2012; Young, Cappola, & Baime, 2009).

There is still disagreement in the literature on the benefits of psychological interventions in general for improving diabetes control. One meta-analysis reported an effect (Ismail, Winkley, & Rabe-Hesketh, 2004) however, one systematic review (Wang, Tsai, Chou, & Chen, 2008) and another meta-analysis (Winkley, Landau, Eisler, & Ismail, 2006) found no effect. Whilst all three of these papers reviewed psychological therapies none of the studies included in the reviews were mindfulness intervention studies.

The aim of the current systematic review is therefore to evaluate the evidence for the use of mindfulness as an effective intervention in the management of both the physical and psychological aspects of having diabetes and diabetes related difficulties.

Review Method

Prior to commencing the main review it was important to establish whether any previous reviews existed. The Cochrane reviews database was searched using the terms “Mindfulness”, “Mindful” and “Diabetes” and their related terms to establish if there were any pre-existing systematic reviews looking at the effectiveness of mindfulness as an intervention to manage diabetes and its related difficulties. The search did not identify any previous reviews that evaluated the use of mindfulness interventions for people with diabetes.

The National Centre for Biotechnology Information (NCBI), Ovid Technologies (Ovid) and Elton Bryson Stephens Company (EBSCO) databases were searched for review articles looking at the effectiveness of mindfulness as an intervention in the management of diabetes and its related difficulties. Searches on these databases were limited to meta-analysis, review and systematic review articles with no date parameters specified. The same search terms as the Cochrane Database were used.

Searches using the Ovid database identified six results. However, none of the results related to the use of mindfulness interventions in people with diabetes. One article looked at issues around health screening. Three of the studies were unrelated to diabetes and unrelated to mindfulness. One study reviewed the use of MBSR with chronic illnesses in general. One study was an animal study looking at the genetic aspects of diabetes.

Searches using the NCBI Databases returned nine results. After closer examination of the titles and abstracts it was found that these articles also did not specifically look at the use of mindfulness in a population of people with diabetes. One of the articles identified looked at the use of complementary therapy as an intervention for a health condition unrelated to diabetes. Two of the articles reviewed the use of MBSR as an intervention for chronic health conditions in general. Three of the articles looked at interventions that were unrelated to mindfulness for health conditions not related to diabetes. Two of the articles discussed aspects of diabetes that were not related to interventions. One article reviewed issues around health screening.

The search on the EBSCO database returned 16 results however, a number of the sub-databases included, did not allow for the filtering of non-review articles. For this reason each of the 16 titles and abstracts were screened to check if the article reviewed the use of mindfulness in a population of people with diabetes and no review articles were found.

It was therefore concluded that no previous reviews had been conducted in this area and that the proposed review would make an important and original contribution to the literature and allow an evaluation of research to date exploring whether mindfulness is an effective intervention in the management of both the physical and psychological aspects of having diabetes and diabetes related difficulties.

A systematic search for research papers looking at mindfulness as an intervention for people with diabetes was therefore undertaken. Searches using the Cochrane Library,

NCBI, Ovid and EBSCO were conducted. The search terms ("diabetes" OR "diabetic") AND ("mindfulness" OR "mindful" OR "mbsr" OR "mbct" OR Acceptance Commitment Therapy) were used and searches were limited to journal articles in the English language with the search terms restricted to abstract, titles and keywords. The databases were searched between the earliest record available and 15th April 2014.

Study Selection

301 references were identified across all the databases (see Figure 1). After removing duplicates 144 references remained. Titles and abstracts of the remaining references were screened to see if they met the following inclusion/exclusion criteria.

Inclusion criteria

- The topic was mindfulness and diabetes or a complication associated with diabetes in a sample of people with diabetes.
- Studies looking at both type 1 and type 2 diabetes were included.
- Mindfulness was investigated as an intervention on its own or mindfulness was a significant part of the intervention discussed such as ACT
- The study reported a quantifiable measure of the impact that mindfulness had on diabetes or a complication associated with diabetes.
- Studies reported results of randomised control trials, controlled studies and uncontrolled studies
- Papers were published in the English language

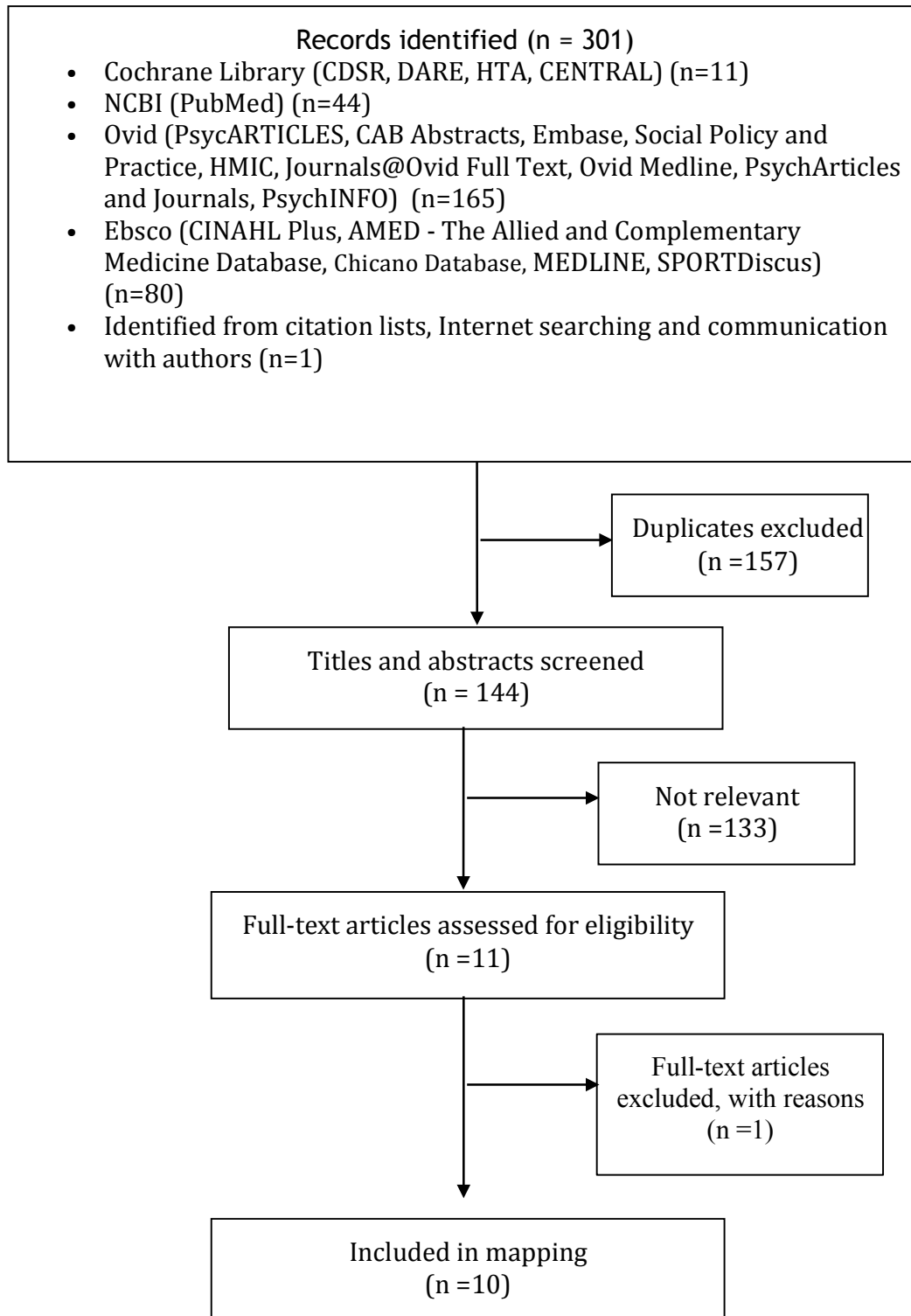
Exclusion criteria

- Papers that did not discuss original data
- Papers that only gave a theoretical position or opinion
- Conference and dissertation abstracts
- Studies that were not published in a journal

Of the remaining 144 studies a total of 133 were excluded. Of these 133 studies, 19 investigated mindfulness but not in type 1 or type 2 diabetes, 40 investigated diabetes but not mindfulness, 44 looked at neither diabetes or mindfulness, four were not published in English, 15 were conference abstracts, 10 did not report original data and one was not published in a journal.

One more study (Son, Nyklíček, Pop, & Pouwer, 2011) was also excluded after examination of the full text as it only reported the research protocol for another of the studies that was already shortlisted. The process of screening the 302 studies is summarised in Figure 1.

Figure 1. Summary of review process



Quality Framework

The ten identified studies were assessed for quality using an adapted version of Downs & Black's (1998) framework. The original 27-item tool designed by Downs and Black (1998, Appendix 1) had a good inter-rater reliability (.75) and test-retest reliability (.99). Item 27 of the original tool, which corresponds to power, was simplified to "Was a power calculation used to calculate sample size reported and if so was the sample actually recruited in line with this calculation?" If a study reported the use of a power calculation to calculate the sample size and recruited in line with the calculation, it was marked 'yes' and scored 1. If a study did not fulfil this criteria it was marked as 'no' and scored 0. The adapted 27-item tool (total score 28) was used as the quality framework for assessing studies that reported Randomised Control Trials (RCT). For Non-Randomised Intervention Studies (NRIS) the same quality framework that was used for RCT studies was used, but items 14, 15, 23 and 24 which referred to randomisation were excluded (total score 24). Each study was evaluated by the author against the relevant framework adapted from the original Downs & Black (1998) framework by assigning a score as specified in the framework (see Table 1). Items 1-4, 6-10 and 27 were scored as 1 point for yes and 0 points for no. Item 5 was scored as 2 points for yes, 1 point for partially and 0 points for no. Items 11-26 were scored as 1 point for yes, 0 points for no and 0 points for unable to determine. The item scores were then totalled to give an overall idea of the quality of the papers and these scores were used to compare the papers to each other.

Table 1 Summary of the quality framework evaluation

	Teixeira (2001)	Hartmann et al (2012)	Young et al (2009)	Rosenzweig et al. (2007)	Schroevers et al (2013)	Son (2012)	Arab- Sheibani (2013)	Gregg et al (2007)	Miller et al (2012) / Miller et al (2014)
1. Is the hypothesis/ aim/objective of the study clearly described?	Yes (1)	No (0)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
2. Are the main outcomes to be measured clearly described in the Introduction or Methods section?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
3. Are the characteristics of the patients included in the study clearly described?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	No (0)	Yes (1)	Yes (1)
4. Are the interventions of interest clearly described?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)

5. Are the distributions of principal confounders in each group of subjects to be compared clearly described?	No (0)	Yes (2)	No (0)	No (0)	No (0)	Yes (2)	No (0)	Yes (2)	Yes (2)
6. Are the main findings of the study clearly described?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
7. Does the study provide estimates of the random variability in the data for the main outcomes?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
8. Have all important adverse events that may be a consequence of the intervention been reported?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
9. Have the characteristics of patients lost to follow-up been	Yes (1)	No (0)	Yes (1)	No (0)	No (0)	Yes (1)	Yes (1)	No (0)	Yes (1)

described?								
10. Have actual probability values been reported (e.g.0.035 rather than <0.05) for the main outcomes except where the probability value is less than 0.001?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
11. Were the subjects asked to participate in the study representative of the entire population from which they were recruited?	No (0)	UTD (0)	UTD (0)	UTD (0)	Yes (1)	UTD (0)	UTD (0)	UTD (0)
12. Were those subjects who were prepared to participate representative of the entire population from which they were recruited?	No (0)	UTD (0)	No (0)	UTD (0)	UTD (0)	UTD (0)	UTD (0)	UTD (0)

13. Were the staff, places, and facilities where the patients were treated, representative of the treatment the majority of patients receive?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	UTD (0)	Yes (1)	Yes (1)
14. Was an attempt made to blind study subjects to the intervention they have received?	Yes (1)	No (0)			No (0)	No (0)		Yes (1)	Yes (1)
15. Was an attempt made to blind those measuring the main outcomes of the intervention?	UTD (0)	UTD (0)			No (0)	No (0)		UTD (0)	UTD (0)
16. If any of the results of the study were based on “data dredging”, was this made clear?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
17. In trials and cohort studies, do the analyses adjust for	Yes (1)	UTD (0)	UTD (0)	Yes (1)	UTD (0)	Yes (1)	Yes (1)	Yes (1)	Yes (1)

different lengths of follow-up of patients, or in case-control studies, is the time period between the intervention and outcome the same for cases and controls?								
18. Were the statistical tests used to assess the main outcomes appropriate?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
19. Was compliance with the intervention/s reliable?	Yes (1)	UTD (0)	UTD (0)	Yes (1)	Yes (1)	Yes (1)	UTD (0)	Yes (1)
20. Were the main outcome measures used accurate (valid and reliable)?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
21. Were the patients in different intervention groups (trials and cohort	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)

[illegible]

Table 2. Summary of reviewed studies

Author	N	Mean age (SD)	Type of study	Intervention	Outcome measure	Type of Diabetes	Country	Key findings
1. Teixeira, E. (2010).	22	0 – 74.6 (10.8)	RCT	Mindfulness Meditation (MM) using an audio CD over 5 Weeks vs. attention placebo group	Neuropathic Pain Scale (NPS), Neurology Quality of Life (NeuroQoL) and the Pittsburgh Sleep Quality Index (PSQI)	Type 1 or type 2	USA	Mean Quality of Life scores were better in MM group
2. Hartmann et al (2012).	110	1 – 58.7 (7.4). C – 59.3 (7.8)	RCT	Mindfulness Based Stress Reduction (MBSR) vs. treatment as usual control	Albuminuria (urine), HbA1c, blood pressure, Patient Health Questionnaire-9 (PHQ-9), Short-Form Health Survey (SF-12)	Type 2	Germany	MBSR helps to lower depression.
3. Young et al (2009)	25	0 - 56 (10)	NRIS	Mindfulness Based Stress Reduction (MBSR)	Profiles of Mood States - Short Form (POMS-SF)	Not specified	USA	Significant improvement in mood pre to post MBSR

4. Rosenzweig et al (2007)	14	0 - 59.2 (2.57)	NRIS	Mindfulness Based Stress Reduction (MBSR)	HbA1c, weight, blood pressure, Symptom Checklist 90-Revised (SCL-90R)	Type 2	USA	Improved HbA1c and blood pressure. Reduced depression, anxiety and psychological distress.
5. Schroevers et al (2013)	24	1 - 54.9 (10.3). C - 55.9 (8.2)	RCT	Individual Mindfulness Based Cognitive Therapy (iMBCT) vs. waiting list control	Center for Epidemiologic Studies Depression Scale (CES-D), PAID (Problem Areas in Diabetes), Five Factor Mindfulness Questionnaire (FFMQ), Self-Regulation Scale (SRS)	Not specified	Netherlands	Reduced depression, diabetes related distress
6. Son (2012)	139	1 - 56 (13). C - 57 (13)	RCT	Mindfulness Based Cognitive Therapy (MBCT) vs. treatment as usual control	Perceived Stress Scale (PSS), HADS, POMS, PAID, 12-item Short-Form Health Survey (SF-12)	Type 1 or type 2	Netherlands	Reduced emotional distress and increases health-related quality-of-life.
7. Arab-Sheibani (2013)	80	0 - 46.17 (SD not reported)	NRIS	Mindfulness Based Cognitive Therapy (MBCT)	PAID (Problem areas in diabetes), Audit of Diabetes-Dependent Quality of Life (ADDQOL19), HbA1c	Type 2	Iran	Improved glycaemic control and quality of life

8. Gregg et al (2007)	81	1-51.9 (SD not reported)	RCT	ACT and Mindfulness and Acceptance Training vs. diabetes education control group.	HbA1c, Diabetes Care Profile (DCP)	Type 2	USA	ACT helped to improve diabetes self-care, and HbA1C	Note
9. Miller et al (2012)	52	1-59.5 (8.2) C-54.0 (7.0)	RCT	Mindfulness Based Eating (MB-EAT) vs. diabetes education control group.	Biometric, HbA1c, Blood Glucose, Diet	Type 2	USA	Both education and MB-EAT helped improve HbA1c and diet.	Ran dom
10. Miller et al (2014)	52	1-59.5 (8.2) C-54.0 (7.0)	RCT	Mindfulness Based Eating (MB-EAT) vs. diabetes education control group	Weight loss, Food Frequency questionnaire (Nutrition Quest), Diabetes Self Efficacy (DSE), Eating Self Efficacy, Three Factor Eating Questionnaire, Beck Anxiety Inventory (BAI), Beck Depression Inventory (BDI-II), Five Facet Mindfulness Questionnaire (FFMQ)	Type 2	USA	Both education and MB-EAT helped improve depressive symptoms, nutrition and eating-related self-efficacy. The availability of both intervention increased patient choice.	ised Cont rol Trial , NRI S - Non-

Randomised Intervention Study, I – Intervention Group, C- Control Group, O - Overall

Results

A total of ten studies were systematically reviewed to explore the evidence base for the use of mindfulness as an intervention for the management of diabetes (see Table 2, numbers in brackets below correspond to study number in Table 2). The number of participants in each study ranged from 14 to 139 with a mean of 59.9 (SD= 41.9). All the studies, apart from two (1, 5), were mindfulness group interventions. Study 1 looked at the use of a guided meditation CD. Study 5 investigated an individual mindfulness intervention. Seven of the studies were RCTs (1, 2, 5-6, 8- 10) and three were NRISs that measured symptoms of diabetes pre and post intervention (3, 4, 7).

One study investigated the benefit of MM on neuropathic pain, QOL and sleep (1), three studies looked at the benefit of MBSR (2-4), three studies looked at the benefit of MBCT (one individual and two group based, 5-7), one study looked at the benefits of ACT with a particular emphasis on mindfulness (8) and two papers explored the use of Mindfulness Based-Eating (MB-EAT, 9-10).

Six papers investigated type 2 diabetes (2, 4, 7, 8, 9, 10), two studies looked at a mixed sample of people with type 1 and type 2 diabetes (1, 6) and two studies did not specify the type of diabetes with which participants had been diagnosed (3, 5).

The studies looked at different aspects of diabetes including: the management of neuropathic pain (1), sleep (1), diabetes control (2, 4, 7-9), emotional adjustment to diabetes (5-7), depressive symptoms/mood (2, 3, 5, 6, 10), QOL (1, 5-7), self-management (8) and diet (8-10). Consequently outcome measures varied considerably;

pain was measured using the Neuropathic Pain Scale (NPS, 1). Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI, 1). Diabetes control was measured using HbA1c, a biological marker of average blood glucose in the preceding 2-3 months (2, 4, 7-9) and Diabetes Self Efficacy (DSE, 9). Emotional adjustment to diabetes was measured using the Problem Areas in Diabetes (PAID, 5-7). Stress was measured using the Perceived Stress Scale (PSS, 6). Anxiety and depressive symptoms were measured using the Patient Health Questionnaire-9 (PHQ-9, 2), Center for Epidemiologic Studies Depression Scale (CES-D, 5), Symptom Checklist 90-Revised (SCL-90R, 4) Hospital Anxiety and Depression Scale (HADS, 6), Beck Depression Inventory (BDI, 10) and Beck Anxiety Inventory (BAI, 10). Mood was measured using the Profiles of Mood States - Short Form (POMS-SF, 3, 6). QOL was measured using the Neurology Quality of Life (NeuroQoL, 1), Short-Form Health Survey (SF-12, 2, 6) and Audit of Diabetes-Dependent Quality of Life (ADDQOL19, 7). Self-management was measured using the Diabetes Care Profile (DCP, 8). The Five Factor Mindfulness Questionnaire (FFMQ, 5, 10) and Self-Regulation Scale (SRS, 5) were used to measure mindfulness and attention. Diet was measured by changes in weight, Food Frequency questionnaire (NutritionQuest), Eating Self Efficacy and Three Factor Eating Questionnaire (10).

Table 2. Summary of reviewed studies

Author	N	Mean age (SD)	Type of study	Intervention	Outcome measure	Type of Diabetes	Country	Key findings
1. Teixeira, E. (2010).	22	0 – 74.6 (10.8)	RCT	Mindfulness Meditation (MM) using an audio CD over 5 Weeks vs. attention placebo group	Neuropathic Pain Scale (NPS), Neurology Quality of Life (NeuroQoL) and the Pittsburgh Sleep Quality Index (PSQI)	Type 1 or type 2	USA	Mean Quality of Life scores were better in MM group
2. Hartmann et al (2012).	110	1 – 58.7 (7.4). C – 59.3 (7.8)	RCT	Mindfulness Based Stress Reduction (MBSR) vs. treatment as usual control	Albuminuria (urine), HbA1c, blood pressure, Patient Health Questionnaire- 9 (PHQ-9), Short- Form Health Survey (SF-12)	Type 2	Germany	MBSR helps to lower depression.
3. Young et al (2009)	25	0 - 56 (10)	NRIS	Mindfulness Based Stress Reduction (MBSR)	Profiles of Mood States - Short Form (POMS-SF)	Not specified	USA	Significant improvement in mood pre to post MBSR

4. Rosenzweig et al (2007)	14	0 - 59.2 (2.57)	NRIS	Mindfulness Based Stress Reduction (MBSR)	HbA1c, weight, blood pressure, Symptom Checklist 90-Revised (SCL-90R)	Type 2	USA	Improved HbA1c and blood pressure. Reduced depression, anxiety and psychological distress.
5. Schroevers et al (2013)	24	1 - 54.9 (10.3). C - 55.9 (8.2)	RCT	Individual Mindfulness Based Cognitive Therapy (iMBCT) vs. waiting list control	Center for Epidemiologic Studies Depression Scale (CES-D), PAID (Problem Areas in Diabetes), Five Factor Mindfulness Questionnaire (FFMQ), Self-Regulation Scale (SRS)	Not specified	Netherlands	Reduced depression, diabetes related distress
6. Son (2012)	139	1 - 56 (13). C - 57 (13)	RCT	Mindfulness Based Cognitive Therapy (MBCT) vs. treatment as usual control	Perceived Stress Scale (PSS), HADS, POMS, PAID, 12-item Short-Form Health Survey (SF-12)	Type 1 or type 2	Netherlands	Reduced emotional distress and increases health-related quality-of-life.
7. Arab-Sheibani (2013)	80	0 - 46.17 (SD not reported)	NRIS	Mindfulness Based Cognitive Therapy (MBCT)	PAID (Problem areas in diabetes), Audit of Diabetes-Dependent Quality of Life (ADDQOL19), HbA1c	Type 2	Iran	Improved glycaemic control and quality of life

8. Gregg et al (2007)	81	1-51.9 (SD not reported)	RCT	ACT and Mindfulness and Acceptance Training vs. diabetes education control group.	HbA1c, Diabetes Care Profile (DCP)	Type 2	USA	ACT helped to improve diabetes self-care, and HbA1C
9. Miller et al (2012)	52	1-59.5 (8.2) C-54.0 (7.0)	RCT	Mindfulness Based Eating (MB-EAT) vs. diabetes education control group.	Biometric, HbA1c, Blood Glucose, Diet	Type 2	USA	Both education and MB-EAT helped improve HbA1c and diet.
10. Miller et al (2014)	52	1-59.5 (8.2) C-54.0 (7.0)	RCT	Mindfulness Based Eating (MB-EAT) vs. diabetes education control group	Weight loss, Food Frequency questionnaire (Nutrition Quest), Diabetes Self Efficacy (DSE), Eating Self Efficacy, Three Factor Eating Questionnaire, Beck Anxiety Inventory (BAI), Beck Depression Inventory (BDI-II), Five Facet Mindfulness Questionnaire (FFMQ)	Type 2	USA	Both education and MB-EAT helped improve depressive symptoms, nutrition and eating-related self-efficacy. The availability of both intervention increased patient choice.

Note: *RCT* – Randomised Control Trial, *NRIS* – Non-Randomised Intervention Study, *I* – Intervention Group, *C* - Control Group, *O* - Overall

For the purpose of this review the papers will be categorised by one of the five types of mindfulness intervention they used (see Table 2). There is considerable overlap between each of the types of mindfulness interventions as they are all based on similar theoretical and philosophical ideas. Hence, it is acknowledged that there will be a large amount of overlap in the techniques used in the interventions.

MM and diabetes

The philosophy and practice of MM originates from Buddhism however, it is also widely practiced in a secular form. The practice typically involves sitting and paying attention to experiences in a non-judgmental way and without emotional attachment. Focusing on the breath, parts of the body or letting go of thoughts are common MM practices. Unlike other forms of meditation MM does not require deep concentration but instead works towards an awareness of one's environment (Dumoulin, 1992).

Teixeira (2010) conducted an RCT to explore the benefits of MM on QOL, pain intensity and sleep quality in people with painful diabetic peripheral neuropathy, in comparison to an attention-placebo group. This study scored 22/28 (RCT) on the quality framework adapted from Downs & Black (1998). The intervention group was provided with a guided MM CD, which they listened to five days per week over a four-week period. The attention-placebo group was provided with nutritional information and was asked to maintain a food diary for four weeks.

The results from Teixeira (2010) suggested there was no significant improvement in overall QOL. There was however a small effect (Cohen $f=0.7$) on pain QOL, a subscale on the NeuroQoL (Vileikyte et al., 2003) measure. Analysis of the effect on pain intensity showed that after controlling for baseline pain intensity and pain unpleasantness there was no significant change in post intervention pain intensity.

Whilst this paper had a small sample ($N=20$) the demographic characteristics of the sample seem to be similar to what has been reported in the literature with regards to age, years with diabetes, and years with painful symptoms (Gore, Brandenburg, Hoffman, Tai, & Stacey, 2006). The study did not find any significant differences on overall scores in any domain investigated. Whilst there was no significant improvement on pain intensity there is indication that MM improved pain QOL in the intervention group albeit with a small effect size. A larger sample size may better determine the effect between groups on pain QOL. Although a sample of 210 would be needed for a medium to small effect ($f=0.16$), a speculation regarding significance cannot be made based on the findings of this study (Teixeira, 2010).

MBSR and diabetes

Jon Kabat-Zin originally developed MBSR for people experiencing chronic pain and stress (Kabat-Zinn & Hanh, 2009; Kabat-Zinn, 1982). Typically MBSR is a structured 8–10 week group intervention. Sessions run on weekly basis and tend to last two and a half hours. Some MBSR programmes also offer a single all-day session known as ‘the retreat’. Each of the eight weekly sessions covers a different aspect of mindfulness practice and topics that are examined within the context of mindfulness. Common mindfulness

practices covered are the mindfulness of breath, mindfulness of activity and mindfulness of the body. The development of mindfulness relies on regular and repeated practice and so participants are also required to practice 45 minutes of mindfulness every day during the eight-week group programme (Grossman et al., 2004).

Hartmann et al. (2012), Rosenzweig et al. (2007) and Young, Cappola, & Baime, (2009) investigated the benefits of MBSR for people with diabetes. These studies scored 18/28 (RCT), 17/24 (NRIS) and 14/24 (NRIS) respectively on the quality framework adapted from Downs & Black (1998). In one study, MBSR was found to reduce levels of depressive symptoms and improve the general health of people with diabetes (Hartmann et al., 2012). Furthermore, regular attendance to the MBSR programme was also found to decrease the experience of psychological distress up to 12 months post intervention (Hartmann et al., 2012). However, even though this is an RCT, these findings should be interpreted with caution as the severity of depressive symptoms at baseline in the sample used in Hartmann et al. (2012) was lower than expected in a typical sample of people with diabetes (Anderson, Freedland, Clouse, & Lustman, 2001). Thus, it is more accurate to say that based on this paper, MBSR prevents the progression of depression rather than prevention of emotional distress.

Support for the positive impact of MBSR on mood was also found by Rosenzweig et al. (2007). This study reported that MBSR not only improved symptoms of depression but also improved symptoms of anxiety and reduced psychological distress. Further support for the positive impact of MBSR on mood and distress reduction was found in Young et al. (2009). This study found that there was a significant improvement in mood

post-MBSR in comparison to pre-MBSR. When the scores were compared to the general population norms it was found that people with diabetes had higher distress pre-MBSR and similar levels to the general population post-MBSR.

With regard to physical indicators Rosenzweig et al., (2007) found that MBSR improved HbA1c levels (a measure of glycaemic control). This improvement was not only found during the eight-week period of the MBSR course but also at follow up a month after the programme.

The findings of Hartmann et al., (2012) suggested that apart from diastolic blood pressure MBSR did not lead to significant improvement in physical health indicators associated with diabetes complications such as albuminuria (a measure of kidney damage). An improvement in markers such as albuminuria maybe expected as research has shown that psychological distress plays a role in the development of diabetes related complications such as nephropathy (de Groot, Anderson, Freedland, Clouse, & Lustman, 2001; Lin et al., 2010) and MBSR reduces psychological distress (Marchand, 2012).

MBCT and diabetes

MBCT was originally developed by Segal, Williams, & Teasdale (2002) as intervention for people with recurrent depression. In depression MBCT is used whilst a person is in remission with the aim of helping them to notice and respond to early warning signs of relapse. MBCT has a similar eight-week structure to MBSR and also emphasises the

practice of mindfulness meditation. MBCT combines MBSR with aspects of Cognitive Behavioural Therapy (CBT) for depression. A MBCT programme typically focuses on the cultivation of awareness through mindfulness practice, an attitudinal framework which emphasises acceptance and a genuine interest in experience and a process of linking learning to an understanding of working with vulnerability (Crane, 2013).

Schroevers et al. (2013), Son et al. (2012) and Arab-Sheibani et al. (2013) investigated the benefits of MBCT for people with diabetes in improving QOL, glycaemic control, stress, anxiety and depressive symptoms. These studies scored 20/28 (RCT), 23/28 (RCT) and 15/24 (NRIS), respectively, on the quality framework adapted from Downs & Black (1998). Arab-Sheibani et al. (2013) and Son et al. (2013) investigated MBCT interventions based on the traditional eight-week group format in comparison to treatment as usual. However, Schroevers et al. (2013) looked at the use of MBCT in individual therapy (iMBCT) in comparison to a waiting list control group, although this still mostly followed the same eight week structure stipulated by Segal et al. (2002) some modifications were made. The length of sessions was reduced from 120-150 minutes to 60 minutes. This meant shortening the exercises to suit the session length and removing the cognitive exercise in session 2 and the relapse prevention exercise in session 7. The psycho-education content was also adapted to focus on a broad range of stress- and depression-related symptoms.

MBCT in comparison to treatment as usual was not found to significantly improve glycaemic control (Arab-Sheibani et al., 2013; Son et al., 2013). However, in Son et al. (2013) whilst post-hoc analysis showed no change in HbA1c over time for the MBCT

group, a significant increase was found for HbA1c over time in the treatment as usual group. This could suggest that MBCT helps to maintain glycaemic control rather than improve it. The non-significant finding in Son et al. (2013) could also be due to the relatively low mean HbA1c score at baseline of 7.6% (which is just above the target level of 6.5%).

iMBCT was found to reduce levels of depressive symptoms and also reduce the risk of developing depression in the future. These improvements were also seen to be maintained at least three months post intervention (Schroevers et al., 2013). Further support for the benefits of MBCT on reducing emotional distress in people with diabetes was found in Son et al. (2013). This RCT showed that people in the MBCT group compared with the treatment as usual group had a significant reduction in both anxiety (small to medium effect) and depression symptoms (medium effect size).

MBCT was also found to significantly decrease levels of stress (Arab-Sheibani et al., 2013), perceived stress over time (Son et al., 2013) and improve QOL in comparison to treatment as usual (Arab-Sheibani et al., 2013; Son et al., 2013). However a significant difference was not found between MBCT and treatment as usual post intervention (Son et al., 2013). One possible explanation for this is the small number of participants experiencing elevated diabetes distress at baseline. Thus the non-significant change could be attributed to a floor effect. Schroevers et al. (2013) found that iMBCT reduced diabetes related distress. The baseline diabetes related distress in this study was also higher. This would suggest that MBCT could potentially help reduce diabetes related distress in samples of people with elevated diabetes specific stress.

On this basis it would seem that MBCT and iMBCT may be effective interventions for managing comorbid stress, anxiety and depressive symptoms in diabetes. There is some evidence to suggest that iMBCT helps to reduce diabetes related distress but a larger study targeted at people with elevated diabetes distress is needed to investigate the benefits on MBCT.

iMBCT was found to also improve trait mindfulness and attention regulation. Participants in the intervention group were found to be better at regulating their thoughts and emotions and when distracted bring their attention to the present moment rather than functioning on automatic pilot. These findings are in line with the literature that investigated MBCT in the non-diabetes populations (Carmody & Baer, 2008; Nyklíček & Kuijpers, 2008). Unlike the general literature on MBCT (Carmody & Baer, 2008; Nyklíček & Kuijpers, 2008), iMBCT was not found to be associated with an improvement in acceptance and a reduction in being judgmental.

Mindfulness, Acceptance and Values Training (MAVT) and diabetes

Previous research on coping styles has shown that acceptance of diabetes and diabetes-related cognitions are significantly related to lower HbA1c (Richardson, Adner, & Nordström, 2001). Avoidance of negative thoughts and feelings associated with diabetes has been shown to be related to higher levels of depression (Boey, 1999), lower QOL (Coelho, Amorim, & Prata, 2003), and lower adherence to medical regime (Weijman et al., 2005).

ACT (Hayes, Strosahl, & Wilson, 1999) works towards helping a person to accept their feelings and thoughts rather than alter them or stop them. Gregg, Callaghan, Hayes, & Glenn-Lawson (2007) compared the benefits of a one day diabetes education workshop to a one day MAVT combined with a condensed diabetes education workshop. This study scored 22/28 (RCT) on the quality framework adapted from Downs & Black (1998).

Gregg et al. (2007) reported that a diabetes education workshop helped to significantly improve self-management but not diabetes control (as measured by DCP and HbA1c). However, the combination of diabetes education and MAVT not only improved self-management even more but the number of patients (pre-treatment n=11/43, follow up n=21/43) with an HbA1c measure of <6.5% (the recommended level for people with diabetes in USA) at the three-month follow up also increased. Changes in blood glucose from pre-treatment to follow up were mediated by improvement in self-management and diabetes related acceptance. The findings of this study suggest that the incorporation of mindfulness and values such as acceptance into diabetes education workshops may help improve self-management and glycaemic control. However, as there was no further follow up at six-months and beyond it is difficult to know if these changes can be maintained.

Mindfulness Based - Eating Awareness Training (MB-EAT)

Miller, Kristeller, Headings, & Nagaraja (2014) and Miller, Kristeller, Headings, Nagaraja, & Miser (2012) discussed the benefits of MB-EAT for people with diabetes. Miller et al.

(2014) reported on the same data set as Miller et al. (2012) but focused on different aspects of the data set. Both papers score 23/28 (RCT) on the quality framework adapted from Downs & Black (1998). MB-EAT was initially developed to help people with binge eating disorders and obesity (Kristeller & Wolever, 2010). This intervention aims to help people make conscious food choices, develop an awareness of physical vs. psychological hunger and satiety cues, and eating healthfully in response to those cues. The key components of the intervention were MM, mindful eating (including savouring food in smaller quantities), mindful activity and body awareness. The difference between MB-EAT and MBSR seems to be that MBSR has a more generalised focus on being mindful whereas MB-EAT has more of a focus on eating.

Miller et al. (2014) and Miller et al. (2012) compared MB-EAT to Smart Choices (a diabetes education programme with a focus on medical nutritional therapy). Miller et al. (2012) found that both MB-EAT and Smart Choices improved HbA1c and helped people lose weight. However, no significant differences were found between the two intervention groups.

Miller et al. (2014) and Miller et al. (2012) found that participants from both the MB-EAT group and the Smart Choices group reported significant improvements in diabetes related knowledge, outcomes expectations, self-efficacy, overeating and symptoms of depression. These improvements were also maintained at the three-month follow up. However again there were no significant differences in the improvements when the intervention groups were compared. In line with the intervention the MB-EAT group

showed an increase in mindful observing and non-judging and also maintained these changes at the three-month follow up.

Discussion

This is the first literature review of research exploring the benefits of mindfulness for people with diabetes. Although the application of mindfulness in mainstream health care is relatively new, and thus the research looking at the benefits of mindfulness for people with diabetes is still in its infancy, there are some promising outcomes reported in the studies reviewed. The literature seems to focus on five types of interventions that have utilised mindfulness. MM focused on the use of mindfulness meditation practices using a CD. MBSR is a well-established mindfulness intervention (Kabat-Zinn & Chapman-Waldrop, 1998; Kabat-Zinn & Hanh, 2009; Kabat-Zinn, 1982) that incorporates MM as well as number of other aspects of mindfulness. MBCT grew out of MBSR and CBT and has a greater focus on cognition (Segal et al., 2002). MAVT is based on principles of ACT (Hayes et al., 2006, 1999) and mindfulness and also focuses on a position of acceptance of thoughts and feelings associated with diabetes. MB-EAT focuses on mindful eating and also incorporates aspects of MBSR, which include mindful activity, MM and body awareness.

A total of 10 studies were reviewed of which seven were RCTs and three were NRISs. RCTs in which participants are randomly allocated to intervention and control/non-intervention groups are thought to provide the strongest empirical evidence (Gronseth, Woodroffe, & Getchius, 2011). NRISs that follow similar quality criteria as RCTs aside from randomisation can also provide useful evidence. Although, in both cases, if the sample is not representative of a population of people with diabetes then the generalisability of the findings is questionable. An exception to this is if the study is

focused on a specific sub-population and the findings are not generalised to the wider diabetes population.

Most of the research reviewed was well reported with clear aims, hypotheses, participant demographics, measures, interventions and outcomes reported, although in some cases there was a lack of reporting of the characteristics of participants who dropped out. Statistical analyses were clearly explained and time frames for follow-ups were consistent in each study. Overall, there also seemed to be good compliance reported with the intervention.

In the RCT studies participants were usually randomised into groups by a computer and the algorithm used was reported. Participants were blinded from the intervention condition they had been assigned to in four of the seven papers that reported a RCT but it was not always clear whether the person delivering the intervention or an independent person was collecting the outcomes data. Although most of the data was based on self-reported questionnaires and blood test results, this may not have had much of an impact on the data reported but it does raise the potential of demand characteristics.

Participants for both the intervention groups and the control groups were mostly recruited from the same population and in the same time period. However, the general lack of reporting of the characteristics of the wider participant pool from which participants were recruited makes it difficult to assess if the sample used was representative of the population from which they were recruited. However, the settings

in which the research was conducted were typically representative of where people with diabetes may go for treatment.

Miller et al. (2014) and Miller et al. (2012) reported findings from the same dataset, so the research discussed is based on nine separate data sets. Whilst Son et al., (2013) had the largest sample of 139 participants this study had high attrition. Arab-Sheibani et al. (2013) had a sample of 80 however only 15 were in the intervention group. This, in addition to the small sample sizes used in five of the studies, can increase the likelihood of a type 1 error by showing that there is a significant difference between intervention and non-intervention groups when this may not be the case (Barker, Pistrang, & Elliott, 2003). The high attrition rates in Son et al. (2013) also raises the question of how feasible a multi-session intervention would be in clinical practice.

One of the key issues with research in this area is the onus on participants to maintain mindfulness practices as recommended and the reliance on self-report. To maintain practice at least five days a week as suggested in some interventions is a 'big ask' and often not practical for participants. There is also the issue of reliance on self-report to measure compliance and the participant's desire to please the researcher. Similarly, the majority of the outcome data relied on self-report measures. These can sometimes be lengthy and often complicated, which would have an impact on the way participants respond or result in incomplete measures. Unfortunately, in most cases there is not an alternative option for measuring outcomes though this is something to be mindful of for future studies.

Whilst it is important to have a sample that represents the wider population of people with diabetes for studies measuring the benefits of an intervention for a particular issue in diabetes such as depression, it is important that this is prevalent in the sample at baseline. Lower levels of depression may result in a lack of significant change as a result of the intervention.

With reference to benefits such as improved glycaemic control it is important that studies have multiple longitudinal follow ups. Of the five studies that measured HbA1c changes, four studies measured HbA1c pre-intervention and then followed up at three months and one study measured HbA1c pre-intervention, at three months and then again after a year. Glycaemic control typically measured using HbA1c in the blood provides an average of blood sugars for the past 2-3 months. So to obtain an effective measure of the longitudinal benefits of mindfulness interventions it necessary to follow up for periods of at least six months.

All studies reported that the intervention they were testing was grounded in already established treatment programmes. However, fidelity to the specified treatment programme was not tested in any of the papers. This makes it difficult to assess how closely the specified treatment programme was followed and thus weakens the strength of outcomes reported.

In the studies reviewed there is evidence to support the use of mindfulness with people with diabetes and there are considerable overlaps between the different mindfulness interventions. Some interventions such as MM and iMBCT used mindfulness as an

individual therapy and so differed from the traditional group format of mindfulness interventions. Some interventions focused on specific elements of mindfulness such as MB-EAT and MAVT whilst others combined mindfulness ideas with other established therapy models such as iMBCT and MBCT and some studies used the original MBSR programme.

MM

Teixeira (2010) was the only study that investigated MM for people with diabetes. In this study, participants relied on an audio CD to learn MM. Traditionally in programmes like MBSR mindfulness is learned in a live group session with the opportunity for feedback and discussion. The authors also reported that a number of participants did not complete all sections of the measures, which may have impacted on the post-test scores and attributed this to the complexity of measures like the NeuroQoL.

Due to the small number of significant findings in Teixeira (2010) it is possible that a type I error may have occurred. Owing to the small sample size the study is also prone to a type II error. Thus, the findings cannot be generalised to wider population of people with diabetes. Lastly the study duration was only four weeks, other mindfulness interventions with an emphasis on meditation such as MBSR usually last eight weeks. Furthermore, in these therapy programmes MM is just one component of the intervention. On the basis of this study alone there is little evidence to support the benefits of MM on its own for people with diabetes.

MBSR

Hartmann et al. (2012), Rosenzweig et al. (2007) and Young, Cappola, & Baime, (2009) investigated the use of MBSR for people with diabetes. Rosenzweig et al. (2007) and Young, Cappola, & Baime (2009) suffer two key limitations; neither study used a control group and both studies had a small sample size. The absence of a control group weakens the methodological validity of the study and a small sample size can sometimes inflate the differences between means (Cohen, 1988).

The strongest evidence for the benefits of MBSR comes from Hartmann et al. (2012) with some preliminary evidence from Rosenzweig et al. (2007) and Young et al. (2009). Based on the studies reviewed there is support for the positive impact of MBSR in improving mood, symptoms of depression and reducing psychological distress in people with diabetes. There is also some evidence to suggest that MBSR helps to reduce symptoms of anxiety in people with diabetes. MBSR was also found to help improve glycaemic control. The long-term impact of this is the potential reduction in diabetes related complications. However, further longitudinal research with larger sample sizes and control groups is needed to find evidence to support this argument.

MBCT

Schroevers et al. (2013), Son et al. (2012) and Arab-Sheibani et. al. (2013) investigated the benefits of MBCT for people with diabetes. In Arab-Sheibani et al. (2013) measurements of HbA1c were taken at baseline and then eight weeks later at the end of the group intervention. HbA1c gives a measurement of the average blood glucose for the past 2-3 months (Mensing et al., 2006; Snoek, 2002). This would mean that that the

HbA1c measure at the end of the intervention might still be taking diabetes control prior to the start of the intervention into account. A measure of HbA1c three months after the start of the intervention may give a better indication of the effect of MBCT on HbA1c.

Schroevers et al. (2013) did not find iMBCT improved acceptance and reduced being judgmental. This may be due to participants in this study being less practiced in mindfulness. iMBCT in comparison to Segal et al.'s (2002) MBCT sessions were shorter with less emphasis on home practice. Furthermore, the group sharing experience in MBCT may also play a part in improving an attitude of acceptance. The studies using MBCT specifically for diabetes did not measure acceptance and being judgmental and so more research is needed in this area before a conclusion can be formed.

All three studies had small sample sizes (although Arab-Sheibani et al. (2013) had a total sample of 80 only 15 were in the MBCT intervention group, the rest were placed in other groups not reported) and only a small proportion of eligible participants had elevated psychological distress and poor glycaemic control. Furthermore, Arab-Sheibani et al. (2013) only included women in their sample. In light of this it is difficult to generalise the findings of all three of these studies to the wider diabetes population. In addition, there was a significant drop out rate in the MBCT group in Son et al. (2013), with nearly a quarter of people assigned to the MBCT group not completing the intervention (n=18). This may suggest implications for attrition to treatment for MBCT for people with diabetes and perhaps research is needed to explore the reasons why participants dropped out.

The low power in Schroevers et al. (2013) suggests larger studies are needed to verify the benefits of iMBCT. The study also relied solely on psychometric data, which may be prone to reporting biases such as under/over reporting psychological symptoms and misinterpretations of questions. Whilst there are no alternatives to psychometric measures for the constructs Schroevers et al. (2013) were measuring, the additional use of biological measures such as HbA1c or other markers of physical health benefits could have been used.

The best evidence for the benefits of MBCT/iMBCT seems to come from Son et al. (2013) and Schroevers et al. (2013) with some emerging evidence from Arab-Sheibani et al. (2013). Whilst there seems to be no clear evidence on the benefits of MBCT for improving glycaemic control there is some evidence to suggest it helps with maintaining glycaemic control (Son et al., 2013). Further longitudinal research with a larger sample size and a higher prevalence of poor glycaemic control at baseline is needed to conclude whether MBCT helps to improve glycaemic control. There is evidence in the studies reviewed to suggest that MBCT and iMBCT help to reduce symptoms of stress, anxiety and depression in people with diabetes. However, further research is needed to establish any potential benefits to diabetes related distress. Further research is also needed in to the benefits of MBCT in improving trait mindfulness, attention regulation and emotion regulation, acceptance and being non-judgmental.

MAVLT

Gregg et al. (2007)'s paper on MAVT did not assess fidelity despite reporting the intervention was based on a treatment manual. In addition the intervention was only

delivered by one person, which raises the issue of therapist effects. The therapist's style or the therapeutic relationship rather than the intervention itself could have been the reason for the observed effects. Also there was only one post-intervention follow up at three months and so the longer-term benefits of the intervention are unknown. The measure of self-management used in the study only focused on diet, exercise and glucose monitoring. There are other areas such as foot care and drug and alcohol use, smoking that need to be taken into consideration. More generally other areas such as the emotional impact of having diabetes were not measured. Factors such as diabetes-related stress and depressive symptoms (Lin et al., 2004) would have an impact on self-management and diabetes control. In addition by measuring outcomes such as improvement in levels of depression and diabetes related distress additional benefits of MAVT can be explored.

Comparison of the diabetes education workshop and the combined MAVT and diabetes education workshop to a MAVT only group and a control group would give a better idea of what benefit the proposed workshop has over no treatment and whether the combined MAVT and diabetes education workshop has more benefits than an MAVT workshop on its own. Also, further research is needed to explore the differences in outcomes for one-session MAVT interventions in comparison to longer-term multi-session ACT interventions.

MB-EAT

The sample used in Miller et al. (2012, 2014) had a limited ethnic and racial diversity and thus the wider population of people with diabetes was not represented in this

sample. There were also high attrition rates with 24% of participants not completing the intervention. As with other areas of mindfulness based interventions the research in this area is still in its early stages. Further research is needed in the longer-term benefits of both these interventions and to examine whether the interventions are better suited to different types of people. Miller et al. (2014) and Miller et al. (2012) argued that there are no significant differences in the outcomes of an MB-EAT and a Smart Choices intervention and that it is important to have a number of interventions for people with diabetes to choose from. The similar outcomes could also be due to MB-EAT not focusing on other areas of mindfulness as is the case in programmes such as MBSR and so trait mindfulness is not increased.

Mindfulness in general

The research reviewed suggested that mindfulness helped to improve general health amongst people with diabetes (Hartmann et al., 2012) and self-management of diabetes (Gregg et al., 2007). With regards to specific physical health measures, one small study reported that mindfulness helped to reduce diastolic blood pressure (Hartmann et al., 2012) and weight (Miller et al., 2012). There was also some indication that sustained mindfulness practice may help reduce diabetes related complications, although further research is needed to confirm this (Rosenzweig et al., 2007). However, mindfulness was also found not to help with diabetic neuropathy (Teixeira, 2010) and kidney damage (Hartmann et al., 2012). Although, it should also be noted that these conclusions are based on individual studies as there were few overlaps in the outcome measures across studies.

The evidence for improvement on glycaemic control seems to be competing with four studies reporting improvements that were sustained for 3 months (Gregg et al., 2007; Miller et al., 2012; Rosenzweig et al., 2007; Son et al., 2013) and another reporting no significant difference in comparison to treatment as usual (Arab-Sheibani et al., 2013). Closer examination of the quality framework for Arab-Sheibani et al. (2013) showed a number of shortfalls in the methodology and analysis. Thus, on balance it would seem that the stronger evidence comes from Gregg et al. (2007), Miller et al. (2012), Rosenzweig et al. (2007) and Son et al. (2013) and so mindfulness may help improve glycaemic control.

Mindfulness was found to improve general mood in people with diabetes and reduce psychological and emotional distress (Rosenzweig et al., 2007; Son et al., 2013; Young et al., 2009). More specifically the literature suggests that mindfulness helps to reduce levels of general stress, diabetes-specific stress, depressive symptoms and anxiety in people with diabetes (Arab-Sheibani et al., 2013; Hartmann et al., 2012; Rosenzweig et al., 2007; Schroevers et al., 2013; Son et al., 2013). Furthermore, mindfulness was found to reduce the risk of developing depressive symptoms in the future (Schroevers et al., 2013). The general quality of studies in this area varied with scores ranging from 14/24 to 23/28. There was also a mixture of NRIS (3) and RCT (7) studies. However, the consistency in findings across studies suggests that the conclusions from the studies are reliable. Also, despite variation in the type of mindfulness intervention used, results were similar. On this basis it would appear that mindfulness helps to improve mood and reduce stress, depressive symptoms and anxiety in people with diabetes.

With regards to general QOL, MM was found to show no significant improvements (Teixeira, 2010) whilst MBCT did show significant improvements (Arab-Sheibani et al., 2013). With reference to the quality framework Teixeira (2010) was an RCT and scored higher than Arab-Sheibani et al. (2013), which was a NRIS. However, there was also difference in the interventions used therefore, the studies cannot be strictly compared to each other. The comprehensive structure and greater therapist involvement of MBCT compared to MM (which was more of a guided self-help intervention) is likely to have a higher level of adherence influencing the outcome of the intervention.

Limitations

There are a number of limitations to this literature review. Only one person assessed the quality of the studies. Only studies published in journals were included. Also, only studies written in English were reviewed. Although this was intentional, the implications are that other studies may have been excluded as research can be reported in a number of ways, e.g. through conference abstracts or thesis (University of York & NHS Centre for Reviews and Dissemination, 2009). This also opens the review to possible publication bias as often studies showing results that are not significant are not published (Dubben & Beck-Bornholdt, 2005).

The Down's and Black (1998) quality framework has some limitations. Although the framework is designed for the evaluation of quantitative studies in general, it was not developed using studies that focused on psychological interventions. So, issues such as adherence to the treatment model where applicable were not assessed. Whilst the original 27-item tool designed by Downs and Black (1998, Appendix 1) had a good inter-

rater reliability (.75) and test-retest reliability (.99) this was only based on four raters who were all from the same research field.

Another issue to consider is the weighting given to each item. The way in which items are weighted in the original Downs & Black (1998) framework suggests that each of the components assessed (reporting, external validity, internal validity–bias, internal validity–confounding, selection bias and power) are of equal importance. Furthermore, most of the individual items are also weighted equally. On this basis reporting a clear hypothesis/aim/objective is weighted the same as blinding participants to the condition they have been assigned to. It can be argued that not blinding participants to the condition they have been assigned to is more critical than not clearly stating the hypothesis/aim/objective. However, this is not reflected in the way the items are weighted.

Using variations of the same quality framework for both RCT and NRCT studies meant that where applicable all of the studies were evaluated against the same criterion. However, the different total scores for RCTs and NRCTs make it difficult to do a true direct comparison of a RCT to a NRCT. Though, in the absence of an appropriate quality framework that allows for such comparison this seems like the best possible solution. This also means that the reliability statistics are not strictly reflective of the framework employed in this review.

Conclusions

Research exploring the benefits of mindfulness for people with diabetes is still in its early days with data from only a small number of studies published. Some variations of mindfulness interventions with people with diabetes only have one published study.

Future research could also compare the outcomes of different mindfulness programmes as well as other forms of psychological therapy with people with diabetes to see which one has the most benefits or if different mindfulness programmes are helpful for different diabetes-related difficulties.

More generally with regards to the benefits of mindfulness for people with diabetes, the impact of 'trait mindfulness' i.e. a person's innate abilities to be and behave in a mindful way is still to be explored. One could assume that people who have a higher degree of trait mindfulness will have a greater degree of cognitive flexibility, as they are better at adopting a non-judgmental attitude towards experiences (Baer, Smith, & Allen, 2004). By adopting a position of being non-judgmental a person is better at accepting and adapting to changes in their lives. The ability to adapt makes a person less likely to experience diabetes related distress and therefore depression.

Research to date has also only focused on adults with diabetes and no studies were found exploring the use of mindfulness with children and adolescents with diabetes. Once further research has been published there will be scope for a meta-analysis of studies looking at the benefits of mindfulness for people with diabetes.

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Empirical Paper

**Does cognitive flexibility mediate the relationship between
diabetes related distress and depression?**

Abstract

Objective – There is a high prevalence of depression amongst people who have diabetes. Research has suggested that it is the stress associated with having diabetes that leads to depression rather than merely a diagnosis of diabetes. Depression has been shown to affect areas of the brain associated with cognitive flexibility. Probabilistic Reversal Learning Tasks (PRLT) have been used to measure cognitive flexibility in previous studies. This study aimed to test if the relationship between diabetes related distress and depression is mediated by cognitive flexibility.

Design – A cross-sectional design with 21 participants with a diagnosis of diabetes was used in this study.

Method - Participants completed a computerised PRLT, Diabetes Distress Scale and Patient Health Questionnaire – 9 (a measure of depression). Blood glucose, HbA1c, BMI, IQ, working memory and learning were also measured.

Results – Correlational analysis found that performance on the PRLT was not significantly related to age, blood glucose, HbA1c, BMI, IQ, working memory or learning. Mediation analysis showed that there was no significant relationships between depression, diabetes related distress and cognitive flexibility.

Conclusions – The relationship between diabetes related distress and depression was not mediated by cognitive flexibility. Reasons for the lack of significant findings are discussed. Finally, recommendations and improvements for future research in this area are made.

Introduction

There is a well established relationship between diabetes and depression (Egede & Ellis, 2010). A systematic review and meta-analysis show that people with diabetes are twice as likely to experience depression compared to people who do not have diabetes (Anderson, Freedland, Clouse, & Lustman, 2001). Diabetes refers to a group of metabolic conditions in which a person's blood glucose is too high resulting in the body being unable to use it properly. Some of the common symptoms of undiagnosed diabetes include passing urine more frequently than usual (particularly at night), increased thirst, extreme tiredness, unexplained weight loss, slow healing cuts and wounds and blurred vision. The two most prevalent types of diabetes are type 1 and type 2. In type 1 diabetes, the pancreas stops producing insulin. In type 2 diabetes, the pancreas does not produce enough insulin or the insulin produced does not work properly (Choices, 2013).

Diabetes is a chronic health condition in which there is a big emphasis on patient self-management. In type 1 diabetes self-management involves self-administering insulin (usually via injections) at various times during the day. In type 2 diabetes the glycaemic control is first attempted by dietary control. If this is not possible then oral tablets are prescribed and if glycaemic control is still not achieved, then insulin can be prescribed. Regular blood glucose monitoring is also a key part of both type 1 and type 2 diabetes self-management. Glycaemic control in diabetes is measured through HbA1c in the blood. HbA1c indicates the average blood glucose levels over a 2-3 month period. The level of HbA1c in the blood indicates how well a person is self-managing their diabetes (Koenig et al., 1976). In the UK the target HbA1c levels for adults is 6.5% (48 mmol/mol). HbA1c is measured at least twice a year for people who have diabetes

(NICE, 2009b). It is important to maintain good glycaemic control as poor glycaemic control has been shown to lead to diabetes related complications (Dagogo-Jack & Alberti, 2002). Both the stability and level of HbA1c is used as an indication of whether or not a person's diabetes pharmacological management and self-management is effective (NICE, 2009b).

The prognosis of diabetes depends on how well a person adheres to their self-management regime. As well as glycaemic control, there are a number of psychological factors that contribute to poor self-management. These include not accepting the diagnosis of diabetes, depression, believing that treatment will not have any impact on diabetes and diabetes related distress (Naude, 2007). Diabetes related distress refers to the distress that arises from a person with diabetes' concerns about diabetes management, support, emotional burden, and access to care. Each of these psychological factors could also make it difficult for a person to adapt to having diabetes.

Depression is a term used to describe a number of clinical conditions in which prolonged (usually at least 2 weeks) low mood and/or loss of pleasure in most activities is a key feature (NICE, 2009). Other symptoms of clinical depression include significant changes in weight when a person is not dieting, disrupted sleep patterns, feeling restless, feeling fatigued, feeling worthless/excessive or inappropriate guilt, difficulty with concentration and thoughts of suicide/self-harm (*Diagnostic and Statistical Manual of Mental Disorders*, 2013).

Many chronic health conditions have been associated with an increased prevalence of depression and mood disorders. . In comparison to other chronic health conditions such as arthritis and asthma the prevalence of depression amongst people with diabetes is lower. However, in diabetes depression has a greater impact on perceived health (Moussavi et al., 2007). Furthermore, diabetes is unique because it puts the burden of invasive blood glucose monitoring, diet management and insulin management on to the person with diabetes (Harris, 2003). Depression is particularly prevalent amongst people with diabetes who have comorbidities such as cardiovascular conditions and diabetes related complications (de Groot et al., 2001; Pouwer et al., 2003) and increased levels of diabetes related distress (Pouwer et al., 2005). Treating depression in people with chronic health conditions such as diabetes can lead to an improvement in quality of life. It is common for people with chronic health conditions to have recurring episodes of depression. There are a number of pharmacological and psychological interventions for the management of recurrent depression. Mindfulness Based Cognitive Therapy has been shown to be an effective intervention for recurrent depression (Teasdale & Segal, 2007; Teasdale et al., 2000) and is also recommended by the National Institute for Health and Care Excellence (NICE, 2009a).

One study has suggested that there is a strong relationship between symptoms of depression and diabetes related distress in people with type 1 diabetes. This relationship was found to be independent of complication status, duration of diabetes and gender (Lloyd, Pambianco, & Orchard, 2010). Another recent study has suggested there is a relationship between diabetes related emotional distress and poorer treatment adherence and glycaemic control in adults with type 2 diabetes and

depression. These relationships were found to be partially mediated through perceived control over diabetes (Gonzalez, Shreck, Psaros, & Safren, 2014). Schmitt et al. (2014) found that higher diabetes distress and more depressive symptoms correlated with higher diabetes non-acceptance. Van Bastelaar et al. (2010) reported that diabetes distress partially mediated the relationship between depressive symptoms and glycaemic control in people with type 1 and type 2 diabetes. Furthermore, this relationship was found to be independent of type of diabetes but this may be due to participants being recruited from tertiary diabetes clinics increasing the likelihood of that more complex type 2 diabetes cases were included. So it can be seen that there is a relationship between symptoms of depression and diabetes related distress and that diabetes related distress impacts treatment adherence and glycaemic control.

The relationship between stress and depression (Brown & Harris, 1978; Kendler, 1999; Mitchell, Parker, Gladstone, Wilhelm, & Austin, 2003) and severe psychological stress and first onset depression (Kendler, 1999; Mitchell et al., 2003) has also been well established in the general population.

The relationship between stress and depression can also be explained by the neurotrophin hypothesis of depression, which suggests that stress reduces the production of Brain Derived Neurotrophic Factor (BDNF, Karege et al., 2002). BDNF is a protein essential for the survival of neurons in the developing and adult brain (Duman, Malberg, Nakagawa, & D'Sa, 2000) and hence neuroplasticity (Egede & Ellis, 2010). Neuroplasticity is a term that refers to changes in neural pathways and synapses as a

result of changes in our behaviour, environment and neural processes as well as changes ensuing injury.

Studies have shown that mindfulness helps enhance neuroplasticity as measured by Diffusion Tensor Imaging (DTI, a type of Magnetic Resonance Imaging) and electroencephalography (EEG) during a Time Production (TP) task (Berkovich-Ohana, Glicksohn, & Goldstein, 2012; Tang, Lu, Fan, Yang, & Posner, 2012). If mindfulness helps to enhance neuroplasticity it may also help to increase BDNF. Previous research has suggested a link between BDNF and diabetes where by BDNF has been shown to help glucose metabolism independent of diet related behaviour (Gotoh et al., 2012). If mindfulness does help to increase BDNF production then in theory it may also help with glucose metabolism. However, further research is needed to confirm this.

People who are more mindful have also been shown to perform better on cognitive flexibility tasks (Moore & Malinowski, 2008). Borkev (2002) proposed that mindfulness could enhance behavioural flexibility, in that people who were more mindful were better at adapting the way they responded in situations based on actual rather than imagined contingencies. This may also suggest that people who are more mindful are better at adjusting to a diagnosis of diabetes. However, again further research is needed to confirm this.

BDNF is expressed in the hippocampus and prefrontal cortex. These are both brain regions that are found to be structurally altered in depression and thought to play a critical role in learning and memory (Egan et al. 2003; Pezawas et al. 2004). Reduced

neural plasticity as result of reduced BDNF levels in the hippocampus and prefrontal cortex may explain the memory problems and executive functioning deficits widely reported in those suffering from depression (Burt, Zembar & Niederehe, 1995; Channon & Green, 1999). Previous animal studies have found that stress reduces levels of BDNF in the hippocampus and prefrontal cortex and antidepressant treatment can increase BDNF in these areas (Calabrese, Molteni, Racagni, & Riva, 2009; Smith, Makino, Kvetnansky, & Post, 1995).

Studies have shown that hippocampal-dependent learning is impaired in mice, which have been genetically altered to produce lower levels of BDNF (Gorski, Balough, Wehner & Jones, 2003). Reduced levels of BDNF in the rat brain have been found to impair spatial learning (Mizuno, Yamanda, Olario, Nawa & Nabeshima, 2000). Moreover, low levels of BDNF appear to disrupt memory recall/retention. Human studies have shown BDNF levels have been found to positively correlate with verbal memory performance (Grassi-Oliveira et al. 2008). These results suggest reduced BDNF levels are associated with learning and memory deficits and in theory cognitive flexibility.

In the present study a Probabilistic Reversal Learning Task (PRLT) is used to measure cognitive flexibility through reversal learning (RL), an ability that allows us to adapt our behaviour in response to changes in stimulus-reward contingencies (Happel et al., 2014; Hornak et al., 2004; Rolls, Hornak, Wade, & McGrath, 1994).

Research has also established that participants with depression perform worse on PRLTs than healthy controls (Remijnse et al., 2009; Robinson, Cools, Carlisi, Sahakian, &

Drevets, 2012; Taylor Tavares et al., 2008). However, little is known about the performance of people with diabetes on PRLTs.

PRLT performance has been associated with functioning in the ventrolateral, dorsomedial and dorsolateral prefrontal cortices as well as the anterior prefrontal/insular and cingulate cortices (Cools, Clark, Owen, & Robbins, 2002; Freyer et al., 2009; Taylor Tavares et al., 2008). PRLT task performance is also affected in people with frontal lobe lesions (Daum, Schugens, Channon, Polkey, & Gray, 1991) and more specifically with lesions in the ventral prefrontal cortex (Rolls et al., 1994). fMRI studies have shown activation in the ventrolateral and dorsomedial prefrontal cortex and the dorsolateral prefrontal, anterior prefrontal/insular and cingulate cortices during PRLTs (Freyer et al. 2009; Cools et al. 2002; Taylor Tavers et al. 2008). A more recent fMRI study showed a strong relationship between RL and the ventral prefrontal cortex in a sample of healthy volunteers (Nagahama et al., 2001). Furthermore, studies using animal models have also linked the hippocampus to performance on PRLTs (Duffy, Labrie, & Roder, 2007; Kanoski, Meisel, Mullins, & Davidson, 2007; Schrijver, Pallier, Brown, & Würbel, 2004; Tsetsenis et al., 2011). The hippocampus and prefrontal cortex have also been associated with BDNF production (Egan et al., 2003; Pezawas et al., 2004; Wu, Hill, Klug, & van den Buuse, 2012). On this basis it is suggested that the performance on the PRLT (and therefore cognitive flexibility) is associated with areas of the brain associated with depression and BDNF production (and therefore neuroplasticity).

In summary, there is a well-established link between depression and diabetes, also between depression and poor performance on the PRLT (and therefore cognitive

flexibility). Mindfulness has been found to increase neuroplasticity and there is some evidence to suggest that people who are more mindful perform better on cognitive flexibility tasks. Poor glycaemic control has been linked to diabetes related distress, depression, poor diabetes self-management and diabetes complications. As poor glycaemic control is related to a number of diabetes related difficulties it is important to monitor it regularly in clinical practice as it may prompt clinicians to investigate further for any of these underlying difficulties.

The current study aims to investigate if the relationship between diabetes related distress (as measured by the Diabetes Distress Scale) and depressive symptoms (as measured by the PHQ-9) is mediated by cognitive flexibility (as measured by the PRLT). The mechanism by which this happens may be a difficulty with adapting to having diabetes, which increases stress and leads to depression i.e. a person who is more cognitively flexible will be better at adapting to having diabetes and so less likely to experience diabetes related distress and depression.

Method

Participants

The inclusion criteria were: having a diagnosis of type 1 or type 2 diabetes for at least two years; aged between 18 and 70 years; no major modifications in their treatment of diabetes (e.g. transfer to insulin) in the 6 months preceding the date of testing, no current use of antidepressant medication and no history of stroke.

All participants were asked to provide their age, sex, marital status, employment, education, ethnicity, history of depression, medication use, weight and height, duration of diabetes, type of diabetes, current treatment of diabetes, and co-morbid conditions.

A total of 21 participants (10 male) with a mean age of 53.29 years ($SD = 12.03$, Range = 26-69) took part in the study. Sixteen participants were from a White ethnic background, four participants were of Asian/British-Asian background and one participant was of Black/British-Black background. One participant was single, two participants were cohabiting, 16 participants were married and two participants were divorced. One participant was in full-time education, five participants were employed full-time, three participants were employed part-time, one participant was self-employed, four participants were not employed and seven participants were retired. Ten participants had left full-time education after high school, six participants had completed a college level course and five participants had completed a university or professional qualification. Participants had a mean length of diagnosis of 16.52 years (Range = 2-36, $SD = 10.09$). Seven participants had a diagnosis of type 1 diabetes and 14

had a diagnosis of type 2 diabetes. Five participants reported a history of depression and one participant reported a current diagnosis of depression based on participant self-report.

Measures

IQ

The Wechsler Test of Adult Reading (WTAR) was used to estimate IQ as this was thought to impact on performance on the PRLT. This test comprises of a person reading a list of 50 words that have atypical grapheme to phoneme translations. Each correctly read word gives one point and the test is discontinued after 12 consecutive incorrect pronunciations. The total score (ranging from 0-50) is then converted to a WTAR estimated Full Scale IQ (WTAR-FSIQ) score using Strauss, Sherman, & Spreen (2006).

Working memory and learning

The Rey Auditory Verbal Learning Test (RAVLT) was used to measure working memory and learning. Working memory and learning were also thought to impact PRLT performance. The RAVLT consists of five learning or acquisition trials. Each acquisition trial involved the experimenter reading 15 semantically unrelated words (List A) in a fixed order to the participant at the rate of one word per second. After each trial the participant attempted to recall as many words as possible in any order. After the fifth acquisition trial a second list of fifteen words (List B) was read to the participant followed by free recall of this list. Free recall was then attempted of the original list (List A) without the list being re-read to participants. In line with Strauss et al. (2006), performance on trial I of the RAVLT was used as a measure of working memory. The

free recall score (trail VI) was used as a measure of learning (Ryan, Rosenberg, & Mittenberg, 1984)

Depression

Depression was measured using the Patient Health Questionnaire-9 (PHQ-9, Spitzer, Kroenke, & Williams, 1999). The PHQ-9 is a self-administered depression measure, which rates each of the nine DSM-IV criteria of depression from "0" (not at all) to "3" (nearly every day) with reference to the past 14 days. The measure produces a score from 0-27 and classifies participants on the basis of total score as 'not depressed/remission' (0-4), 'mild depression' (5-9), 'moderate depression' (10-14), 'moderately severe depression' (15-19) and 'severely depressed' (20-27).

Diabetes related distress

Diabetes related distress was measured using the Diabetes Distress Scale (DDS; Fisher, Glasgow, Mullan, Skaff, & Polonsky, 2008). This is a 17-item self-report measure that aims to measure patient concerns about disease management, support, emotional burden, and access to care. Participants were asked to rate the 17 items in terms of their experience over the past month using a 6-item Likert scale ranging from 1 (not a problem) to 6 (a very serious problem).

Diabetes control

Diabetes control was measured using HbA1c levels. HbA1c gives an indication of the average blood glucose over a 2-3 month period (Koenig et al., 1976). This was obtained

from the participant's hospital records. It is normal practice for this blood test to be performed as part of the participant's routine diabetes review. The most recent test result was used and all tests were within a month of the research appointment.

Blood glucose

Blood glucose was measured on the day of the research appointment using a blood glucose monitor and a small drop of blood taken from the participant's fingertip using a sterile needle. The drop of blood was placed on to a test strip, which was connected to a glucose monitor. The monitor analysed the sample and provided a blood glucose level. To ensure consistency all samples were analysed using the same Accu-Chek Aviva blood glucose monitor.

Height, weight and BMI

Height and weight were measured using a stadiometer and weighing scale. These measurements were then used to calculate Body Mass Index (BMI). The greater a person's BMI the greater their risk of certain conditions such as diabetes, heart disease and hypertension.

Cognitive flexibility

Cognitive flexibility was measured using a computerised PRLT. The PRLT used in this study was based on Cools, Clark, Owen, & Robbins (2002). Participants were shown 100 sets of stimuli showing a square and a circle. The side of the screen on which each shape appeared varied; in 50 sets the square was on the right and the circle on the left and in

the other 50 sets the square was on the left and the circle on the right. The task involved selecting one of the two shapes by pressing '1' or '2' on the keyboard. '1' referred to the shape on the left and '2' referred to the shape on the right. The aim of the task was to ascertain which the correct stimulus was and adapt when the correct stimulus had changed. If the correct shape was chosen a green smiley face was presented and if an incorrect shape was chosen a red sad face was presented. Participants were given up to two seconds to respond after which the next stimulus was presented. In cases where no response was made the trial was recorded as timed out and coded as a false response. The participant's selection of the shape was based on both accurate and misleading feedback. The feedback received was probabilistic in the sense that 80% of the time the feedback was accurate while 20% of the time misleading feedback was given. The correct shape switched after the participant had identified it correctly six times irrespective of the feedback given. The number of switches made was used as the outcome measure for this task as a greater number of switches would suggest the participant adapted quicker to changes in the stimulus and thus was more adaptable to change.

Procedure and design

Ethical approval was obtained from the Coventry & Warwickshire National Research Ethics Service (NRES) Committee West Midlands prior to the commencement of the study (appendix 2 - ethics approval letter).

A cross sectional design was used in this study. Participants were recruited from a hospital outpatient diabetes clinic through posters advertising the study and

conversations with their diabetes consultant during their appointment. Those interested in finding out more about the study were asked to speak to the researcher who was available in the waiting room. Following a conversation with the researcher people who expressed an interest in taking part were provided with an information sheet (appendix 3) and asked to complete an initial screening questionnaire to ensure they met the inclusion criteria (appendix 4). If they met the inclusion criteria they were booked in for a research appointment. Participants who did not meet the inclusion criteria were thanked for their time.

On the day of the appointment, participants were asked to complete the consent form (appendix 5) and demographics form (appendix 6). Next participants were asked to measure their blood glucose after which they completed the PRLT. The researcher then administered the WTAR and RAVLT. Finally, the participant completed the PHQ-9 (appendix 7) and the DDS (appendix 8). At the end of the appointment participants were paid up to £5 to cover the cost of their travel or parking.

Statistical analysis

The results of this study were analysed using IBM SPSS Statistics version 21. Descriptive statistics were conducted to describe the sample and variables measured (appendix 9). A two-tailed Pearson Correlation test was then used to test the relationships between the variables (appendix 10). Finally, the procedure described in Preacher and Hayes (2004, 2008) was used to test if the relationship between diabetes related distress (as

measured by DDS) and depression (as measured by PHQ-9) was mediated by cognitive flexibility (as measured by the switch rate on the PRLT, appendix 11)

Results

Table 1 – Demographic and Descriptive Information

Variable	Mean	SD	Range
Age	53.29 years	12.03	26-69
N years with diabetes	16.52 years	10.09	2-36
BMI	31.18	8.41	19.63–51.48
HbA1c	8.18%	1.09%	6.4%-10.5%
Blood glucose at start of PRLT	9.06 mmol	2.7	4 – 13.9
WTAR	100.33	14.6	75-110
RAVLT Trial I	-0.097	1.35	-2-3
RAVLT Trail VI	0.43	1.06	-1.48-1.82
PHQ-9	7.14	5.43	0-16
DDS	1.94	0.77	1.18–4
PRLT Switch Rate	8.19	2.29	1-12

BMI- Body Mass Index, PRLT – Probabilistic Reversal Learning Task, WTAR – Wechsler Test of Adult Reading, RAVLT – Rey Auditory Verbal Learning Task, PHQ-9 – Patient Health Questionnaire-9, DDS – Diabetes Distress Scale

Descriptive information

The mean BMI for the sample was 31.18 (SD= 8.41, Range= 19.63-51.48), which is categorised as obese. The mean HbA1c level for the sample was 8.18% (SD= 1.09%, Range= 6.4% - 10.5%). This is above the target range of 6.5% suggesting that overall the sample did not have the recommended level of diabetes control. At the point of

completing the PRLT task participants had a mean blood glucose level of 9.06 mmol (SD= 2.7, Range= 4 mmol – 13.9 mmol).

The estimated mean IQ score based on the WTAR for the sample was 100.33 (SD= 14.6, Range= 75-110). The mean IQ score for the sample is close the expected UK norm of 100 (SD=15, Green et al., 2008). Scores on the RAVLT were converted into z scores using the age specific norms stipulated in the RAVLT manual. This would mean that the scores now accounted for age specific differences and were transformed so that the mean RAVLT score for each trail was 0 (SD=1). The mean and SD were then calculated for the z scores. Scores for trail I were used to measure working memory. The mean RAVLT z score for trail I was -0.097 (SD= 1.35, Range= -2-3), suggesting the overall score was below the expected level. Scores on trial VI were used as a measure of learning. The mean score on trial VI of the RAVLT was 0.43 (SD= 1.06, Range= -1.48-1.82) suggesting that the scores were above the expected levels. i.e. the working memory ability in this sample was below the expected level but the learning ability was above the expected level.

The mean depression score for the sample was 7.14 (SD= 5.43; Range= 0-16), which falls into the mild depression range. Nine participants' scores were in the minimally depressed range (0-4); five participants' scores fell in the mildly depressed range (5-9), five participants scored in the moderately depressed range (10-14) and two participants scored in the moderately severe range.

Scores on the DDS are interpreted using the 'mean item score'. Interpretation corresponds to the Likert scale description corresponding to the 'mean item score' i.e. a 'mean item score' of 3 would be interpreted as moderate distress. The mean 'mean item score' for the sample was 1.94 (SD= 0.77, Range= 1.18–4). A score of 1 is interpreted as 'not distressed' and a score of 2 is interpreted as 'slight distress' thus a score of 1.94 falls just below slight distress. A mean item score of ≥ 3 has been considered to suggest significant levels of distress. Three participants had a mean item score of ≥ 3 . The total score of the DDS can also be used for analysis. The mean DDS total score for the sample was 32.95 (SD=13.06; range 20 - 68).

The mean number of switches made by participants on the PRLT was 8.19 (SD=2.29; range 1 - 12). The maximum possible number of switches that a participant could make was 16. Normative data was not available for this task, so it is not possible to interpret this score with regards to a reference group.

Correlations

In the absence of any previous studies exploring this, in order to ensure that the switch rate on the PRLT was not influenced by age, BMI, glycaemic control blood glucose levels, general intelligence, working memory and learning (which would suggest the need to correct for this), measures of all of these variables were correlated with the number of switches on the PRLT. A Pearson correlation analysis showed there was no significant correlation between the switch rate and age ($r= 0.01$; $p= 0.96$), switch rate and BMI ($r= 0.004$; $p= 0.98$), switch rate and blood glucose levels ($r= 0.94$; $p= 0.68$), switch rate and glycaemic control ($r= -0.17$; $p= 0.46$), switch rate and estimated IQ ($r= 0.28$; $p= 0.22$),

switch rate and working memory ($r = 0.25$; $p = 0.27$) or switch rate and learning ($r = 0.36$; $p = 0.11$).

Table 2 – PRLT Switch Rate Pearson correlation analysis

		Variables						
		Age	BMI	Blood glucose	Glycaemic control	IQ	Working memory	Learning
PRLT	r	0.010	0.004	0.094	-0.171	0.280	0.251	0.357
Switch Rate	p	0.964	.986	0.684	0.458	0.220	0.272	0.112

BMI – Body Mass Index, IQ- Intelligence Quotient, PRLT – Probabilistic Reversal Learning Task

A Pearson correlation analysis (summarised in Table 3) was then done to test the relationships between diabetes related distress (as measured by the DDS), depression (as measured by the PHQ-9) and cognitive flexibility (as measured by switch rate on the PRLT). There was no significant correlation between depression and diabetes related distress ($r = 0.12$; $p = 0.6$), depression and cognitive flexibility ($r = 0.33$; $p = 0.15$) or diabetes related distress and cognitive flexibility ($r = 0.06$; $p = 0.81$). Arguably the lack of significance maybe due to small sample sizes, so mediation analysis using the bootstrap method was performed (MacKinnon & Fairchild, 2009; Preacher & Hayes, 2004, 2008).

Table 3 – DDS, PHQ-9 and Switch rate Pearson correlation analysis

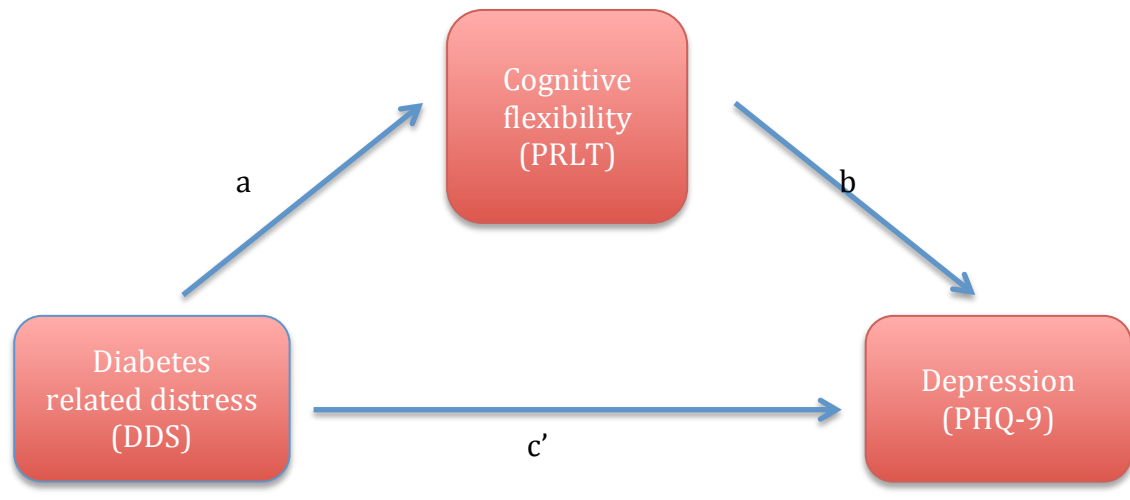
	DDS (Z-Scores)	PHQ-9 (Z-Scores)	N Switches (Z-Scores)
DDS (Z-Scores)			
r	-	0.328	0.055
p		0.147	0.811
PHQ-9 (Z-Scores)			
r	0.328	-	0.122
p	0.147		0.598
N Switches (Z-Scores)			
r	0.055	0.122	-
p	0.811	0.598	

DDS – Diabetes Distress Scale, PHQ-9 – Patient Health Questionnaire-9

Mediation analysis

In line with the aim of the current study, a mediation analysis was performed to see if the relationship between diabetes related distress (as measured by the DDS) and depression (as measured by the PHQ-9) was mediated by cognitive flexibility (as measured by switch rate on the PRLT). The proposed mediation model is presented in Figure 1. The procedure described in Preacher and Hayes (2004, 2008) was used to conduct the parameter estimation and mediation analysis. All the variables included in the mediation analysis were transformed into standard scores (mean= 0, SD= 1) to allow direct comparison between parameter coefficients with in the mediation model.

Figure 1: The proposed model of the mediating effects of cognitive flexibility upon the relationship between diabetes related distress and depression.



The bootstrap method (MacKinnon & Fairchild, 2009; Preacher & Hayes, 2004, 2008) was used to calculate the tests of significance of the mediated pathway. The beta coefficient was also calculated. The 95% confidence intervals of the parameter coefficient and the mediation test can be assumed statistically significant at $\alpha=0.05$ if the confidence interval does not pass through zero.

There was no significant direct effect (Beta = 0.328, CI -0.126 to 0.781) between diabetes related distress and depression before the mediating effect of cognitive flexibility was accounted for. With the inclusion of cognitive flexibility as a mediating variable the direct effect between diabetes related distress and depression (c' in Figure 1) reduced to Beta = 0.322 (CI -0.144 to 0.788). As both the direct and mediated effects of diabetes specific on depression were found to be non-significant it can be concluded that on the basis of this data set that the relationship between diabetes related distress and depression is not mediated by cognitive flexibility. Therefore there was a null

finding to the proposed hypothesis that the relationship between diabetes related distress and depression is mediated by cognitive flexibility.

Discussion

This study investigated whether or not the relationship between diabetes related distress and depression was mediated by cognitive flexibility as measured by the switch rate on a PRLT based on Cools et al. (2002). The statistical methods outlined in MacKinnon & Fairchild (2009) and Preacher & Hayes (2004, 2008) were used to test the model but no significant mediated relationship between diabetes related distress and depression was found. This is the first study that investigates these relationships using mediation analysis.

Breaking the model into its components, firstly, despite previous studies showing a relationship between diabetes related distress and depression (Fisher et al., 2007; Fisher, Glasgow, Mullan, Skaff, & Polonsky, 2008; Pouwer et al., 2003) and between general stress and depression (Brown & Harris, 1978; Kendler, 1999; Mitchell, Parker, Gladstone, Wilhelm, & Austin, 2003), the results of this study did not suggest any link.

According to one meta-analysis, the prevalence of self-reported depression among people with diabetes is 31% (Anderson, Freedland, Clouse, & Lustman, 2001). More recently, Fisher, Skaff, et al., (2008) measured the prevalence of self-reported depression using the Center for Epidemiologic Studies Depression Scale (CESD), clinical depression using a diagnostic interview and diabetes related distress using the DDS in a sample of people with type 2 diabetes. This study found 22.6% of people self-reported depression but only 10.7% met the diagnostic criteria for depression and 18% had a DDS mean item score ≥ 3 (the stipulated level for clinical significance). This would

suggest that the levels of self-reported depression in samples of people with diabetes are higher than the rates of diagnosable depression.

PHQ scores ≥ 10 have been shown to have a sensitivity of 88% and a specificity of 88% for major depression (Spitzer, Kroenke, & Williams, 1999) and so this will be used as the cut off to compare levels of self-reported depression. In the current study 33.3% ($n=7$) participants had PHQ scores ≥ 10 . With regards to the DDS only 14.3% ($n=3$) had a mean item score ≥ 3 , suggesting the level of self-reported depression was comparable with Anderson, Freedland, Clouse, & Lustman (2001) but higher than Fisher et al. (2008) and the level of diabetes distress was lower than Fisher et al. (2008). Further examination of the PHQ-9 scores shows that only two participants scored in the moderately severe category and no participants scoring in the severe category. So although there may be comparable levels of depression to previously published studies the severity of depression may be lower.

The main theoretical models of emotional distress in diabetes are based on the psychiatric diagnosis of major depressive disorder (Gonzalez, Fisher, & Polonsky, 2011). Most studies including the present study rely on self-report questionnaires that gauge symptoms of distress to measure depression. The PHQ-9 has been shown to be equally accurate as longer clinician administered instruments (Gilbody, Richards, Brealey, & Hewitt, 2007) in populations of people with depression. However, in the context of comorbid physical health conditions self-report measures are still prone to inaccurately pathologise depressive symptoms. The physical symptoms of diabetes can be mistaken for symptoms of depression and whilst self-report measures may have acceptable

psychometric properties in detecting depression in the general population, they are often prone to producing inaccurate measurements in populations of people with comorbid physical health conditions (Thombs et al. 2008). One study using both self-reported measures and diagnostic interviews found that 70% of people with elevated self-reported depressive symptoms did not meet the diagnostic criteria for a major depressive disorder (Fisher et al., 2007). This could mean that scores on the PHQ-9 are measuring both depression and symptoms of diabetes. To overcome this, future studies could use the PHQ-9 and follow up clinical interviews to confirm whether or not a person meets the diagnostic criteria for clinical depression.

Secondly, although previous research has shown a relationship between PRLT and depression (Remijnse et al., 2009; Taylor Tavares et al., 2008), again the data from this study did not find a significant relationship between depression and performance on the PRLT. This again could be due to lower levels of depression as Remijnse et al. (2009) and Taylor Tavares et al. (2008) both used participants who met the diagnostic criteria for clinical depression in comparison to controls.

Another reason could be due to differences in the PRLT task. Remijnse et al. (2009) used a self-paced version of the PRLT, meaning there were no 'timed out' responses and so participants were not penalised for having slower response times. Furthermore, the Remijnse et al. (2009) version switched after every 6-10 correct responses and had 400 experimental trials compared to a switch after six correct responses and 100 experimental trials in this study. Taylor Tavares et al. (2008) also used a PRLT based on Cools, Clark, Owen, & Robbins (2002). However, they presented the task up to eight

times to each participant. This would have meant that in Remijnse et al., (2009) and Taylor Tavares et al. (2008) participants could potentially have a greater number of switches as there were a greater number of experimental trials.

Finally, a relationship between stress and performance on PRLTs has also been reported in previous studies, (Graybeal et al., 2011; Lapiz-Bluhm, Soto-Piña, Hensler, & Morilak, 2009; Rogers, Andrews, Grasby, Brooks, & Robbins, 2000), but no link was found in the current study. This could partly be because the relationships demonstrated in previous studies were demonstrated in animal models in the absence of human studies of stress and PRLT performance. Further human research is needed to explore the relationships between stress and PRLT performance.

Having participants with both type 1 and type 2 diabetes may also have impacted on the findings of this study. Ideally the analysis of the results would have seen if there were any differences in the performance on the PRLT of people with type 1 and type 2 diabetes. However, due to the small sample size it was not possible to compare people with type 1 diabetes to people with type 2 diabetes. Although one meta-analysis has shown that a significant difference in the prevalence of depression in type 1 and type 2 diabetes could not be established (Anderson, Clouse, Freedland, & Lustman, 2001), research has still not looked at the neuropsychological differences between type 1 and type 2 diabetes. So, whether or not neuropsychological differences exist is still unknown. We cannot rule out neuropsychological differences as medically type 1 and type 2 diabetes is defined as separate conditions and so these physiological differences could impact the brain in different ways. Furthermore, type 1 diabetes is usually diagnosed in childhood

or adolescence when the brain is more plastic and therefore better able to adapt. Both of these factors could affect performance on a neuropsychology task such as the PRLT.

One of the difficulties with this study was a struggle in recruiting participants, which is reflected in the small sample size. Participants were recruited from over 40 diabetes outpatient clinics between July 2013 and April 2014. Each clinic had at least 20 patients booked in. This is a potential pool of over 800 participants and does not include potential interest that may have been generated through posters advertising the study. From this pool of over 800 participants, 77 participants expressed interest in taking part in the study but only 21 actually turned up for their research appointments. This suggests that only 2.62% of the potential sample participated in the study. This small proportion of people taking part in the study may have posed biases on the sample. It is possible that only participants who were not depressed or stressed volunteered. This is also reflected in the low levels of diabetes related distress and depression in comparison to the samples used in other published studies.

In addition a large proportion of the population of people with diabetes are of working age and so participation would mean taking time off work, which they are unlikely to do. So, if there was bias in the sample, this potential inconvenience could have biased the sample further. A possible solution to this would be to provide an option to complete the study online. This would allow participants who work during the day to complete the study at their own leisure and increase the likelihood of participants taking part.

Although the present study did not find any significant relationships between depression, diabetes and cognitive flexibility, future studies should continue to research these relationships with a larger sample sizes and in populations with higher representation of people with diagnosable depression.

Future research may also choose to explore the role of trait mindfulness (using measures such as The Kentucky inventory of Mindfulness Skills, Baer et al., 2004) in the relationship between diabetes distress and depression. Trait mindfulness has been suggested to correlate with other cognitive flexibility tasks (Moore & Malinowski, 2009), so it would be interesting to see whether trait mindfulness correlates with performance on the PRLT and then to see whether performance on the PRLT or trait mindfulness best explains the relationship between diabetes distress and depression. The findings of such studies will contribute to our understanding of the relationship between depression and diabetes. Furthermore, they may allow us to develop more specific and tailored treatment programmes for people with diabetes who experience depression.

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PUBLIC DOMAIN BRIEFING DOCUMENT

Diabetes: The benefits of mindfulness interventions and the role of cognitive flexibility.

The following document summarises Volume 1 of a thesis that was submitted as part of the Doctorate in Clinical Psychology at the School of Psychology, University of Birmingham. Volume 1 comprises of a literature review and a research study.

Literature review

Research on the benefits of mindfulness with people who have diabetes was reviewed. Having diabetes can be a stressful experience for a lot of people. Research has shown that mindfulness helps people with and without long-term health conditions to manage stress. The term 'mindfulness' comes from the Pali word 'sati', meaning awareness, attention and remembering (Bishop et al., 2004; Gunaratana & Gunaratana, 2011). Mindfulness tries to help people to learn ways of paying attention to the things they do and experience the things that they do without judging themselves or the activity (Bishop et al., 2004). Mindfulness interventions can be delivered individually to people, in a group or people can teach themselves using recorded exercises, books, websites etc. Some popular mindfulness practices are mindfulness meditation, paying attention during daily activities such as eating and being aware of the way we think about things.

The literature search found ten published studies that looked at the use of mindfulness based interventions for people with type 1 and type 2 diabetes. The studies used different types of mindfulness interventions some focused on a specific area of

mindfulness such as eating whilst others focused on a range of different aspects of mindfulness and techniques.

The review found that practicing mindfulness helped people with both the physical and psychological aspects of having and living with diabetes. Mindfulness was found to help maintain healthy blood sugar levels. For people who have diabetes it is important to be able to maintain good blood sugar levels as having high blood sugar levels can increase the risk of developing other complications. Mindfulness was also found to improve the general health of people with diabetes. Furthermore, there is some preliminary research to suggest that mindfulness helps to reduce diabetes related complications although further research is still needed to confirm this.

The research reviewed found that mindfulness helped to improve the general mood and quality of life of people with diabetes and reduced the experience of emotional distress. Mindfulness specifically helped to reduce levels of both general stress and diabetes related distress as well as symptoms of depression and anxiety.

Though the practice of mindfulness has been around for many centuries, the benefits of mindfulness for people with diabetes have only started to be researched recently. For this reason the research looking at the use of mindfulness with people who have diabetes is still limited. More research is needed to explore the benefits of the different types of mindfulness interventions. The research so far has focused on adults with diabetes but there has been no research with children and young people with diabetes.

So, more research is needed looking at the benefits of mindfulness for children and young people with diabetes.

Empirical paper

The relationship between diabetes and depression has been well established. People with diabetes are twice as likely to experience depression compared to people who do not have diabetes (Anderson, Freedland, Clouse, & Lustman, 2001). One explanation for the relationship between diabetes and depression is that people with diabetes can experience higher levels of stress and that it is the stress related to having diabetes and its associated complications that leads to depression rather than a diagnosis of diabetes per se. Examples of sources of stress for people with diabetes include the daily management of insulin, diet and glucose monitoring as well as the other physical health conditions related to diabetes such as damage to other organs in the body.

The present study looks at whether the relationship between diabetes related distress and depression is the result of a difficulty with being able to adapt to new situations (mental flexibility). Twenty-one adults who had a diagnosis of diabetes for at least two years were recruited from a hospital diabetes clinic. Participants were asked to complete a task on the computer that measured mental flexibility. Depression and diabetes related distress was measured using a self-report questionnaire.

In the context of diabetes, it was thought that a person's mental flexibility might be affected by age, Body Mass Index (BMI), blood glucose, diabetes control, general intelligence and working memory and learning. BMI was calculated from height and

weight measurements. Blood glucose was measured using a glucose monitor and diabetes control was measured using blood test results from medical notes. The researcher administered two further tests. The first test has been used to estimate general intelligence and the second has been used as a measure of short-term memory and learning. Statistical tests showed that there were no relationships between each of these measures and a person's ability to adapt to new situations.

Further statistical tests were used to test the relationships between diabetes related distress and depression, mental flexibility. Contrary to previous research the tests showed that there was no relationships between diabetes related distress and depression and depression and mental flexibility. It was also found that the relationship between diabetes related distress and depression was not affected by mental flexibility.

A number of reasons were suggested for not finding any relationships in this study. The average level of diabetes related distress and depression were low in the sample. Furthermore, the number of people experiencing levels of diabetes related distress and depression above the normal threshold was also extremely low. The sample in this study may have been further biased as only a small proportion of people approached participated and they may not have represented the wider population of people with diabetes. The study involved coming back to the diabetes clinic, which may have been inconvenient for people who have commitments such as work during the day.

Future studies should continue to research in this area using larger sample sizes and in populations with higher levels of depression and diabetes related distress. Studies may

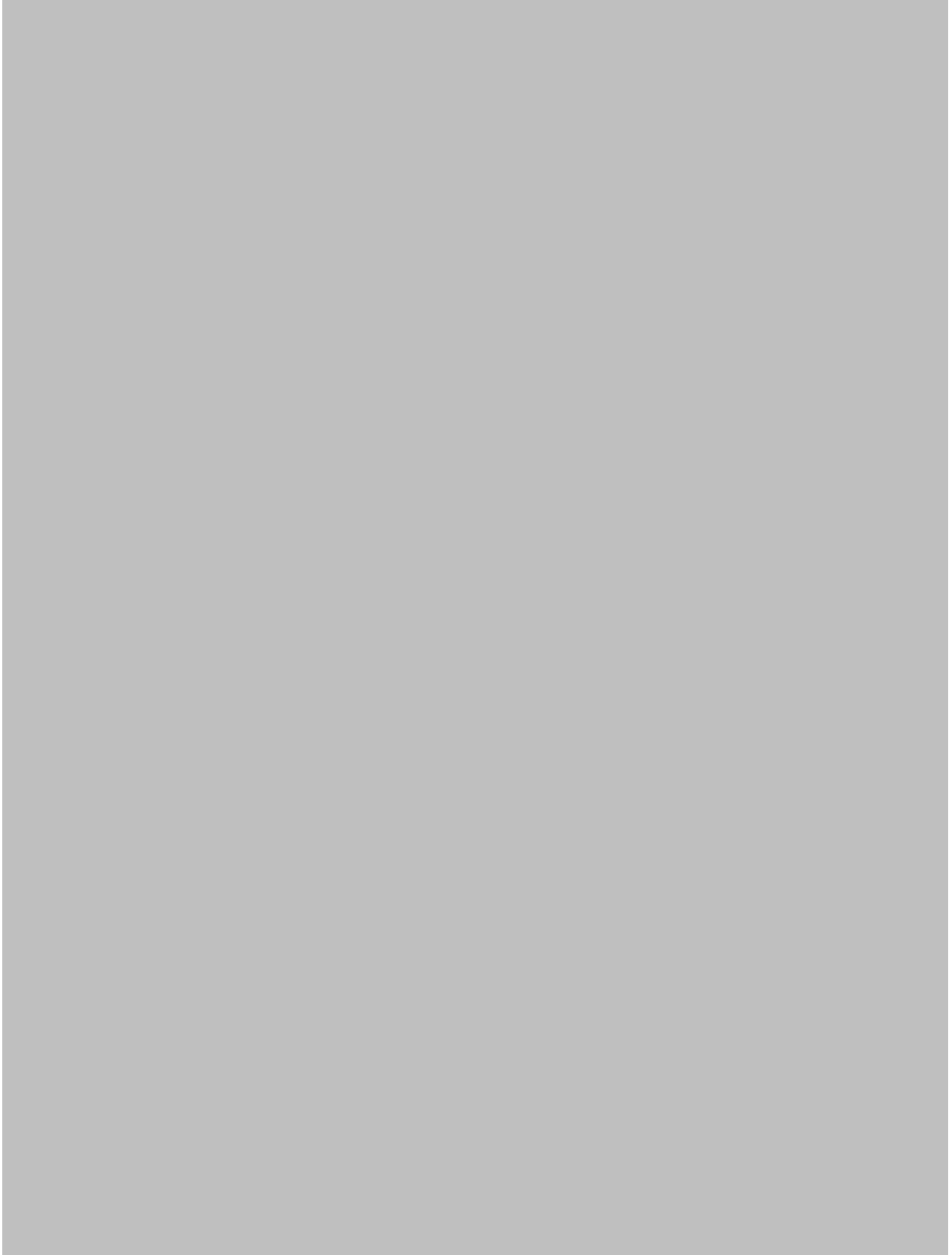
also wish to try and use online versions of the measures in order to increase participation amongst people who find it difficult to commit to research appointments during the day. The findings of such studies will contribute to our understanding of the relationship between depression and diabetes. This is important as it could help us to develop better treatment programmes for people with diabetes who experience depression.

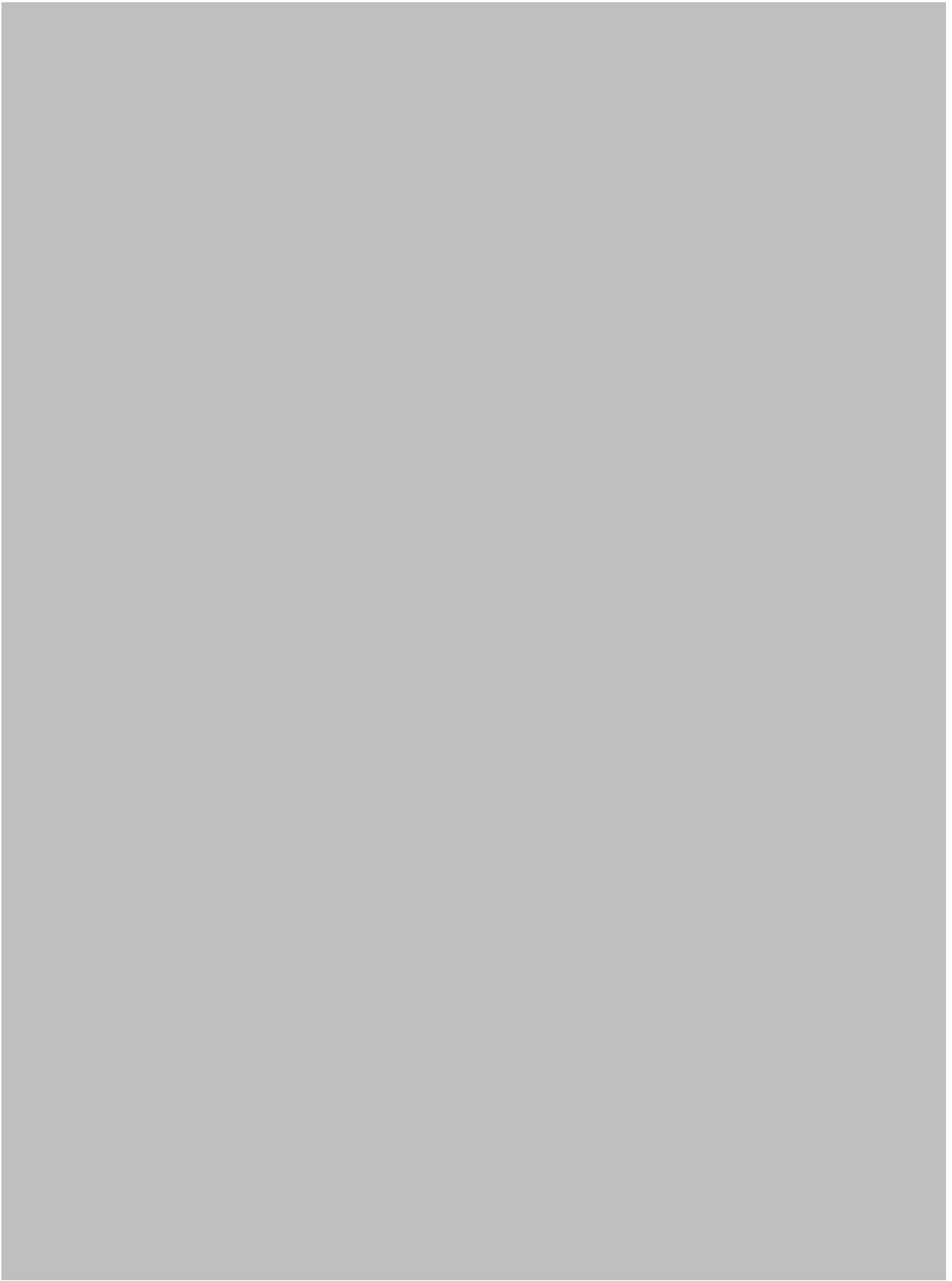
References

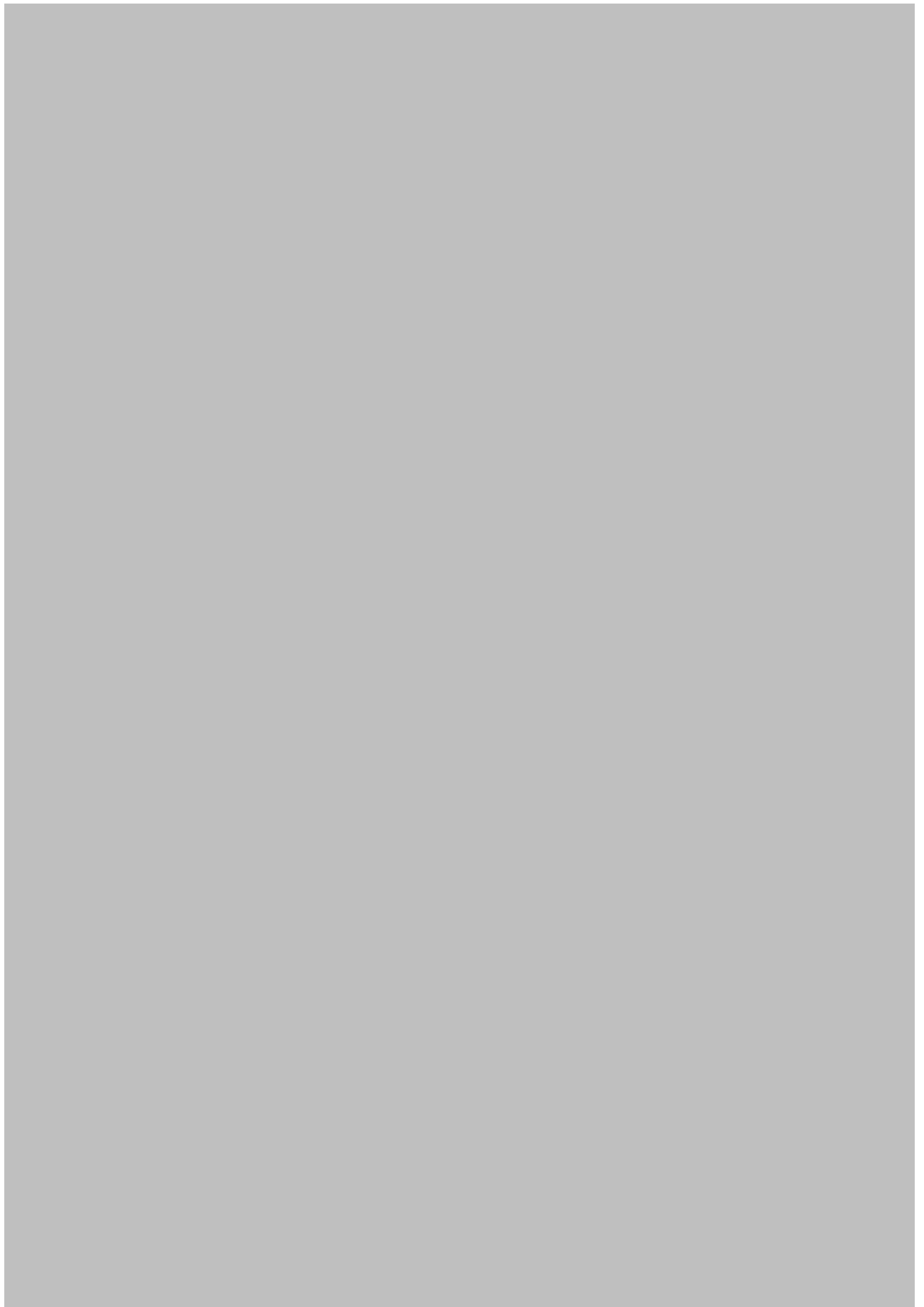
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APPENDIX

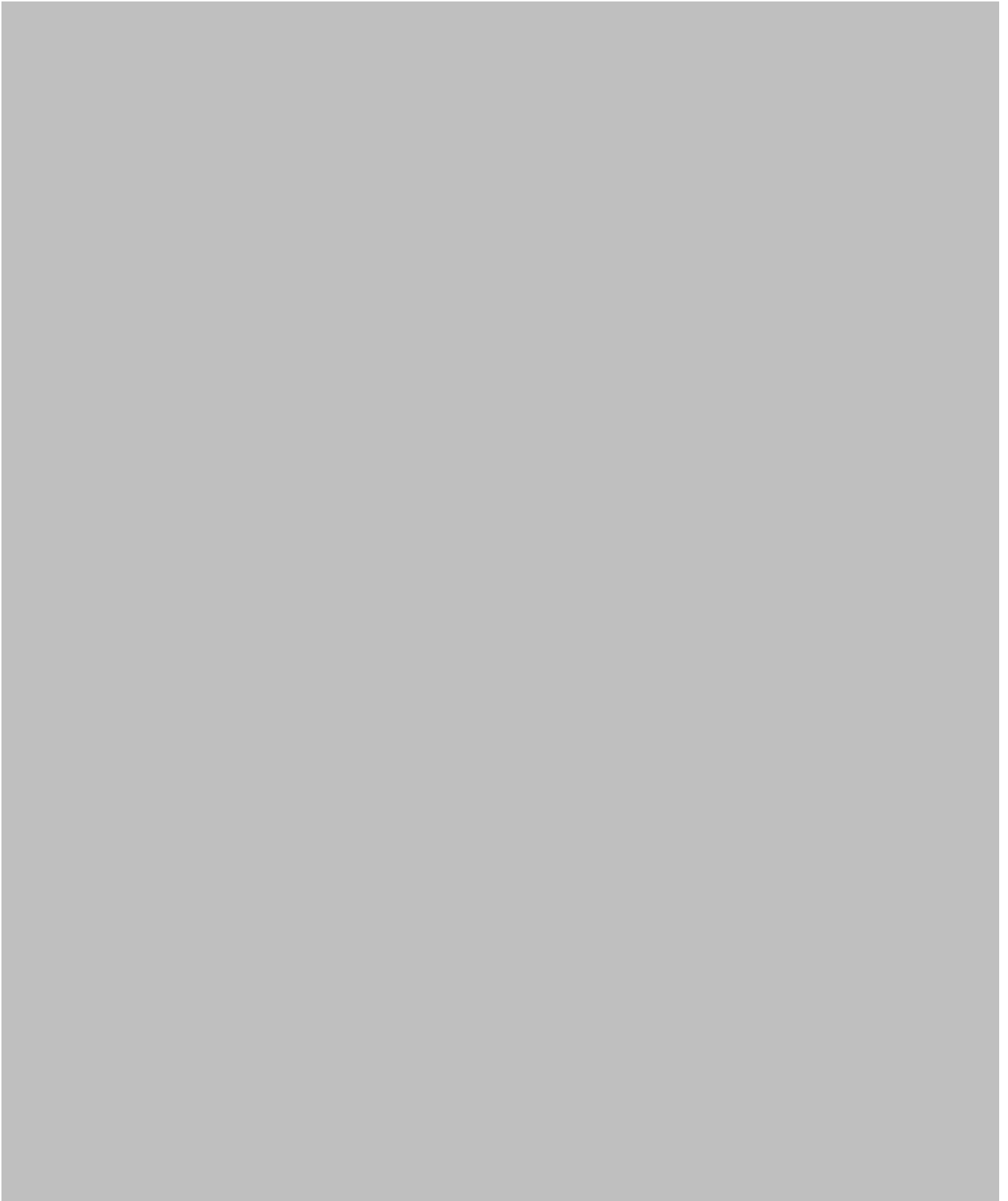
Appendix 1- Original Downs & Black (1998) Quality Criteria

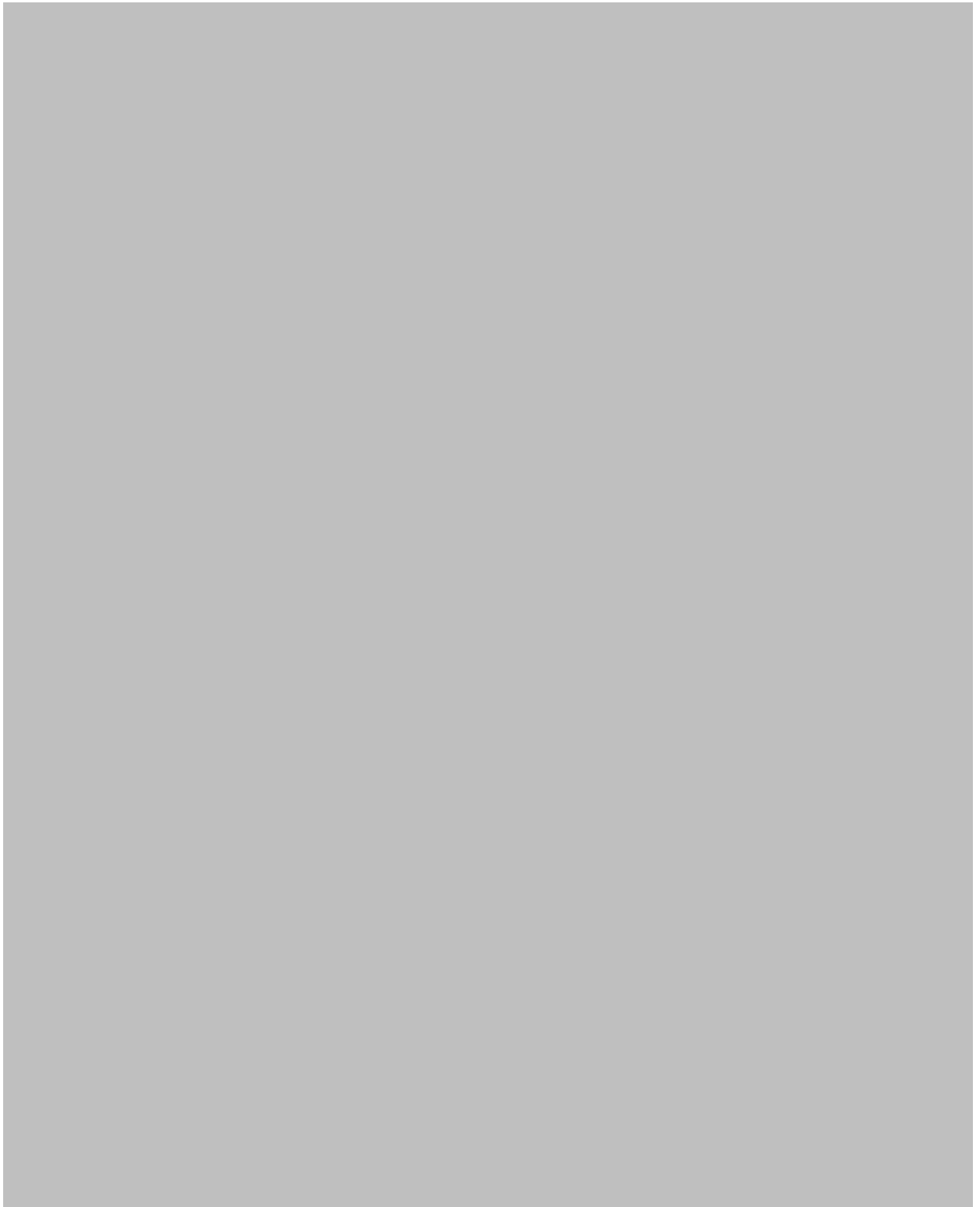


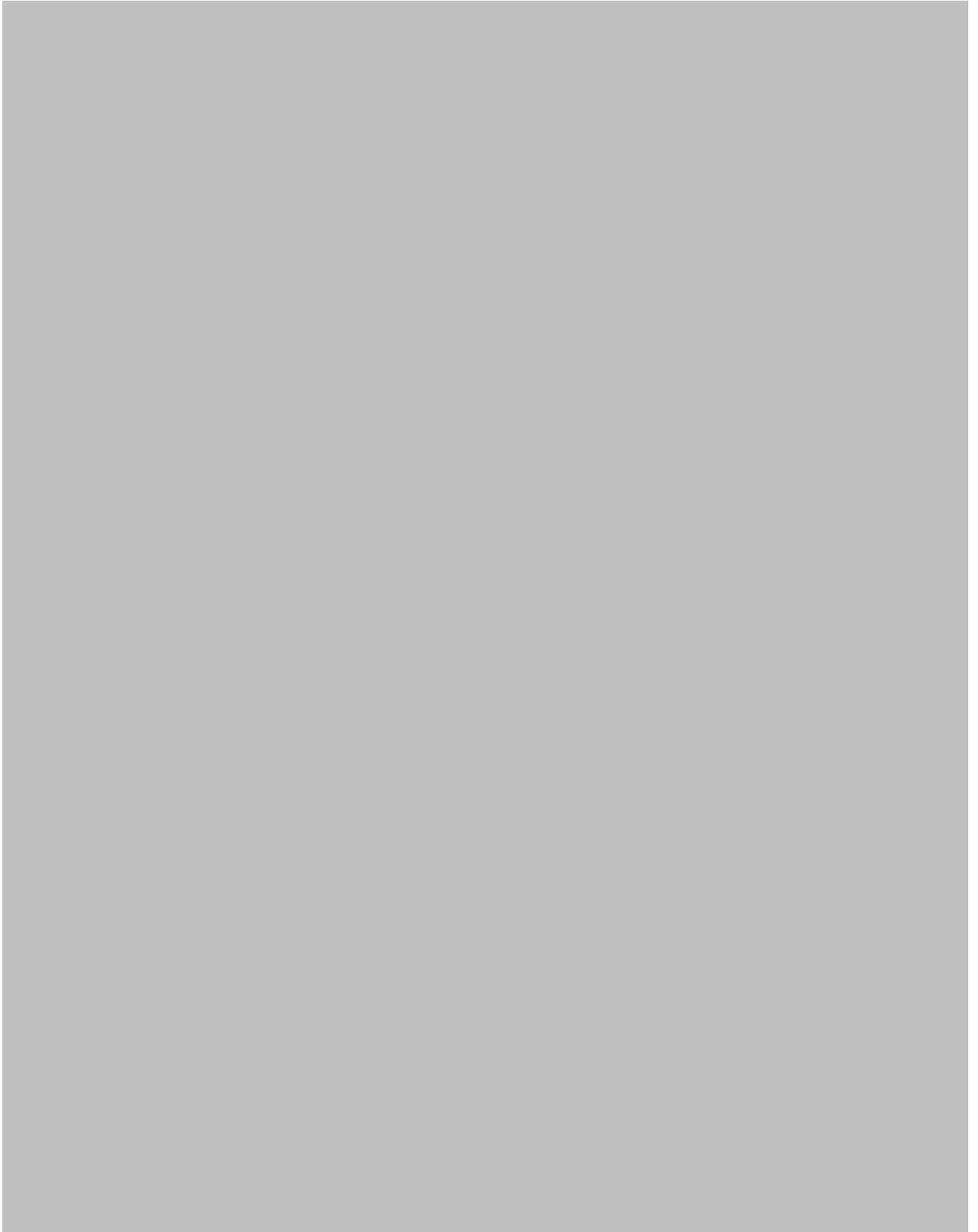




Appendix 2 – Ethics approval letter







Appendix 3 – Participant Information Sheet

UNIVERSITY OF
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Version 4 (17-05-13)/REC reference number: 13/WM/0160

Study Title: The relationship between depression and probabilistic reversal learning in people with diabetes

Participant Information Sheet

We are inviting you to take part in a research study. This study is being conducted as part of a Doctorate in Clinical Psychology. Before you decide whether you want to take part, it is important for you to understand why the research is being done, and what it will involve. We would be grateful if you could take the time to read the following information carefully. Please feel free to discuss it with friends, relatives or your family doctor (GP) if you wish. If there is anything that is not clear, or if you would like more information, please contact the study researcher Chirag Gorasia, whose contact details you will find at the end of this information sheet.

What is the purpose of this study?

The aim of this study is to investigate whether a person's ability to learn new information (probabilistic reversal learning) is associated with in the development of depressive symptoms in people with diabetes. We also aim to investigate whether psychological factors play a role.

Why have I been selected to take part in the study?

All those attending the Heartlands Hospital Diabetes Clinic will be asked to participate in this study.

Do I have to take part?

It is up to you to decide whether or not to take part. This information sheet is provided to help you to make that decision. You will be given time to think about the information in this letter and decide whether or not you wish to take part. Even if you decided to take part, you would still be free to withdraw at any time and would not have to give a reason. A decision to withdraw or not take part in the study would not affect the standard of care you receive.

Any information you provide will be treated as confidential except if we are concerned or worried about your wellbeing or safety. In such circumstances, the researcher will speak to you about what steps you can take and it may be necessary that we contact your GP so that he/she is able to help and support. Your participation in this study would not affect any other support or care that you were receiving

What would taking part in the study involve?

If you agree to take part in the study you will be asked to initially provide your contact details to the researcher. You will then be contacted again to arrange an appointment for you to take part in the study.

When you attend your appointment you will be asked to complete a consent form. You will then be asked to test your blood glucose using a finger prick test similar to the one that you would use to monitor your blood glucose at home. Next you will be asked to complete a small number of tasks that assess various abilities including the way to adapt to learning new information. Finally, you will be asked to complete a number of short questionnaires. The questionnaires, which will assess mood, thoughts, problems with diabetes, and physical activity, should take no longer than 20 minutes to complete.

In order to view your recent results concerning the control of your diabetes (HbA1c results) the research team will require access to your medical records.

After participating in the study you will be reimbursed up to £5 per participant to cover the cost of travel to Heartlands Hospital by public transport. If you travelled by car we will reimburse you for the cost of parking at Heartlands Hospital. Please provide us with a receipt of the parking/public transport costs you have incurred.

Should you score highly on the questionnaire assessing depression, you will be contacted by the researcher, Chirag Gorasia to take part in a more in-depth telephone interview about your mood. This should last no longer than 30 minutes and will enable the team to provide you with tailored feedback on the appropriate next steps to take. If at the time of the interview we have significant concerns about your wellbeing we will liaise with your GP so that he/she can support and advise you.

Who would know about me taking part in the study?

Only members of the research team (Dr Arie Nouwen and Dr Theresa Powell Senior Lecturers at University of Birmingham; and Chirag Gorasia, Trainee Clinical Psychologist, University of Birmingham) and your Diabetes Clinician would know whether you had agreed to take part in the study. We will also inform your GP about your participation.

When writing up the findings of the study the researchers will take care to ensure that they do not reveal the identity of participants. All information that you provide us will be treated as confidential and will not be shared with anyone outside the research team.

What do I have to do?

A member of our research team is available to give you the opportunity to discuss the study in more detail. If, after discussion you are still interested in participating in the study, an appointment can be made for the research to take place. However, if you feel that you must discuss your involvement in the study with your doctor or anyone else, please do.

What are the benefits of taking part?

There are no direct benefits to taking part in the study. However the information we receive from this study may give us a better understanding of the relationship between the ability to adapt to new information and depressive symptoms in people with diabetes. This may help to develop more effective treatment and intervention strategies.

What are the possible disadvantages and risks of taking part?

In the unlikely event that you become distressed as a result of your participation, please let us know using the contact details below. In the first instance we will discuss the difficulties that arose. If you require professional help, we will discuss this with you first and suggest that you contact your GP.

What if something goes wrong?

Once again, if participating in this research project distresses you, you should let us know by using the contact information at the end of this sheet. In the first instance, we will discuss your difficulties with you. If you need professional help, we will speak to you about this and you may then want to contact your GP or Doctor at the clinic.

There are no special compensation arrangements. If you are harmed due to someone's negligence, then you may have grounds for a legal action but you may have to pay for it. Regardless of this, if you wish to complain, or have any concerns about any aspect of the way you have been approached

or treated during the course of this study, the normal National Health Service complaints mechanisms should be available to you.

NHS hospitals have a Patient Liaison and Advisory Service (PALS) and this is an independent route for you to seek advice or express any concerns that you may have. The contact details for Heartlands Hospital, Birmingham is listed below.

Heartlands Hospital PALS: **(0121) 424 1212**

What if I have special needs?

We will make every effort to ensure that there are no barriers for you if you wish to take part. If you have 'communication problems' (due to a disability – e.g. hearing impairment/visual impairment/dyslexia) you are asked to contact us using the details below. If you have difficulties with reading, please inform us. The researcher may be able to offer you more time to complete the study and/or assist you in reading the questionnaire. If you envisage any other problems, please contact the researcher and every effort will be made to make things easier for you.

What would happen to the information I provide?

The questionnaire information will be entered on a research computer at the University of Birmingham and then stored in a locked cabinet at the University of Birmingham. Your information would only be identifiable via a unique study number. The responses would only be used for the purposes of this study, and would be destroyed after a period of ten years.

What will happen to the results of the research study?

The results of the study will be written up in a final report and the results may also be written up in professional journals. When the study is complete you will be sent a letter, which will contain details of the results and any significant findings.

Who is organising the research?

Researchers from the University of Birmingham are organising and conducting the study. The study is being conducted under the direction of Dr Arie Nouwen and Dr Theresa Powell Senior Lecturers at the University of Birmingham. The study researcher is Chirag Gorasia (Trainee Clinical Psychologist, University of Birmingham).

Who has reviewed the study?

The Study has been reviewed and approved by Coventry and Warwickshire Research Ethics Committee.

What if I want further information about the study?



Thank you for taking the time to read this information sheet

Appendix 4 –Initial Screening Questionnaire

UNIVERSITY OF
BIRMINGHAM

Version 1 (20-1-13)/REC reference number: 13/WM/0160

Initial Screening Questionnaire and Contact Details

Participant Details

First Name(s)		Surname	
Age:		Gender	Male/Female
Phone Number		Email	

Please provide details of your next of kin. This person will only be contacted in an emergency.

First Name(s)		Surname	
Relationship			
Phone Number		Mobile	

Please provide details of your GP

Doctors Name	
Name of GP Practice	
Address	
Phone Number	

1. Have you been diagnosed with Diabetes for at least 2 years?
☐ Yes ☐ No
 2. Have you had any major modifications in your treatment for diabetes (e.g. transfer to insulin) during the last 6 months?
☐ Yes ☐ No
 3. Do you have a CURRENT diagnosis of Clinical Depression?
☐ Yes ☐ No
 4. Have you had a diagnosis of Clinical Depression in the PAST?
☐ Yes ☐ No
 5. Are you currently taking antidepressant medication?
☐ Yes ☐ No
-

Appendix 5 –Consent Form

UNIVERSITY OF
BIRMINGHAM

Version 2 (9-04-13)

**Study Title: The relationships between depression and probabilistic reversal
learning in people with diabetes**

Participant Identification Number:

Research Ethics committee number: 13/WM/0160

Consent form for research participants

(Please initial each box)

1.	I confirm that I have read and understood the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	
2.	I understand that my participation in the study is voluntary and that I am free to withdraw at any time during the research, without giving any reason, and without my care being affected.	
3.	I understand that the information which I provide will be treated in confidence and that it will not be shared with any person outside of the research team.	
4.	I agree to allow members of the research team access to my medical records.	
5.	I agree for my GP to be contacted and informed about my participation in this study.	
6.	I confirm that I am willing to take part in this research study.	
7.	I understand that relevant sections of my medical notes and data collected during the study may be looked at by individuals from Birmingham University, from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records	

.....

Name of participant

.....

Date

.....

Signature

.....

Name of researcher

.....

Date

.....

Signature

Appendix 6 – Demographics Information Sheet

UNIVERSITY OF
BIRMINGHAM

Version 2 (03-05-13)/REC reference number: 13/WM/0160

Study Title: The relationships between depression and probabilistic reversal learning in people with diabetes

Participant Identification Number: _____

Demographic Information Sheet

1) How old are you? _____

2) When were you first diagnosed with diabetes? _____ (year)

3) What type of diabetes have you been diagnosed with?

☐ Type 1 ☐ Type 2

4) Which ethnic group do you belong to? **Please tick the box.**

- ☐ **White:** British, Irish, or any other
- ☐ **Asian or Asian British:** Indian, Pakistani, Bangladeshi, or any other
- ☐ **Black or Black British:** Caribbean, African, or any other
- ☐ **Chinese**
- ☐ **Any other Asian background**
- ☐ **Mixed background (e.g. White and Black , Black and Asian, or any other)**
- ☐ **Other** _____

5) What is your weight? _____ stone & pounds / kilograms (please circle)

6) What is your height? _____ feet & inches / metres (please circle)

7) Do you suffer from any illnesses or health problems apart from diabetes?

☐ Yes ☐ No

If yes please could you state which of the following health problems you suffer with:

☐ Hypertension ☐ High Cholesterol ☐ Heart Condition
☐ Kidney Condition ☐ Stroke ☐ Other(s)

If other(s) please specify

8) Do you suffer from any health problems/complications due to your diabetes?

☐ Yes ☐ No

If yes please could you specify which problems you suffer with:

☐ Ketoacidosis ☐ Hypersmolar Syndrome ☐ Retinopathy (Eyes)
☐ Nephropathy (Kidney) ☐ Neuropathy (Nerves) ☐ Diabetic Foot
☐ Peripheral Vascular Disease ☐ Cerebrovascular disease ☐ Other(s)
☐ Diabetes related skin condition ☐ Cardiac Autonomic Neuropathy I

If other(s) please specify

9) What is your current marital status? **Please tick the box.**

☐ Single ☐ Co-habiting ☐ Married ☐ Civil Partnership ☐ Divorced
☐ Widowed

10) What is your education level?

☐ Primary School ☐ Secondary School ☐ College ☐ University/Professional qualification

11) What is your current employment status? If currently on maternity leave please tick the box that applied to you before taking leave.

Please tick one box.

- ☐ Full Time Student ☐ Full Time Employed ☐ Part Time Employed ☐ Self Employed
☐ Not Employed

12) What is your present occupation? (JobTitle) _____

13) How do you control your diabetes (tick all that apply)

- ☐ Diet only
☐ Tablets (how many tablets per day _____?)
☐ Insulin (how many injections per day _____?)
☐ Insulin pump

14) Do you have a current diagnosis of depression? ☐ Yes ☐ No

15) Have you been diagnosed with depression in the past? ☐ Yes ☐ No

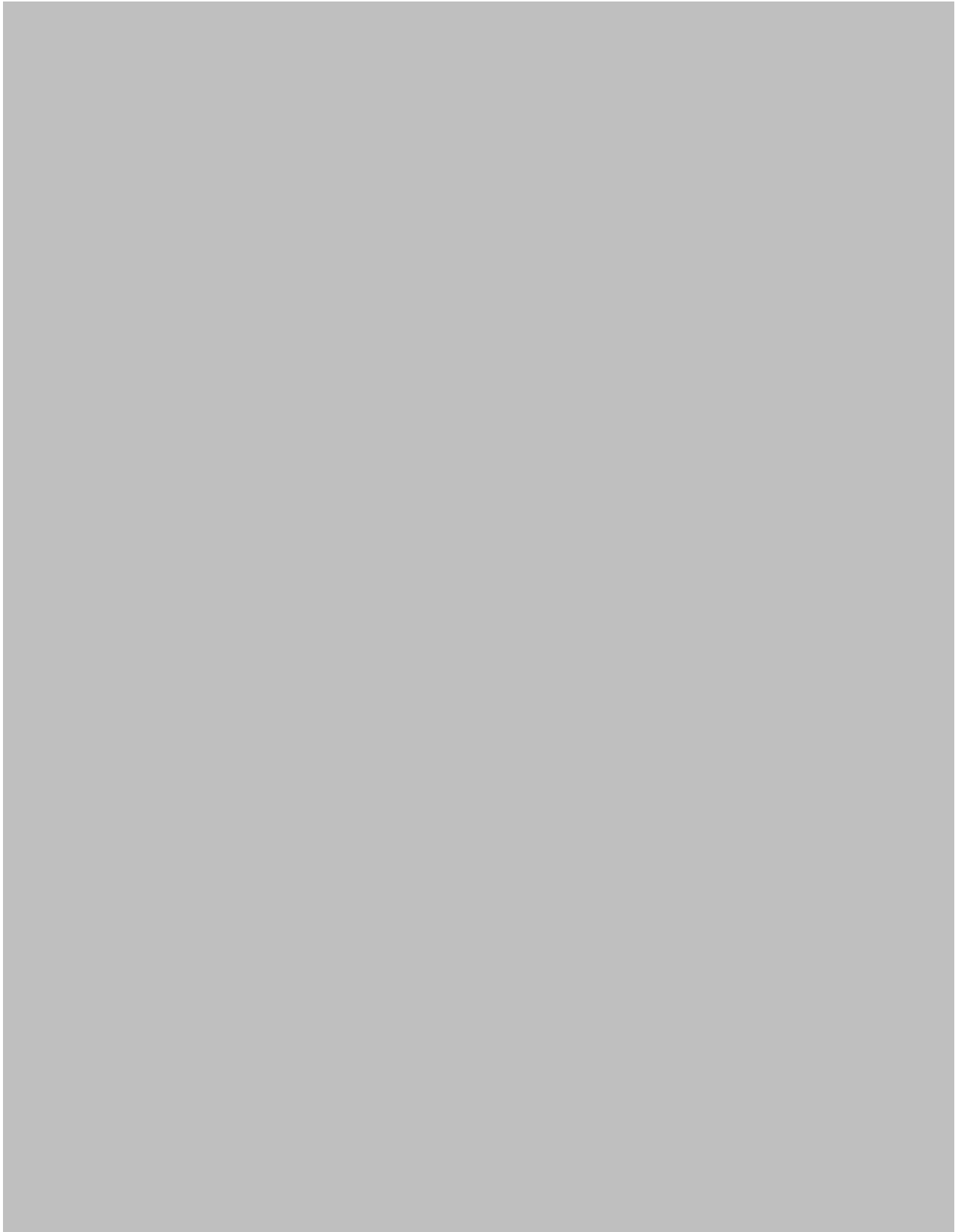
16) Are you currently taking any anti-depressant medication? ☐ Yes ☐ No

17) Are you currently taking any other medication? ☐ Yes ☐ No

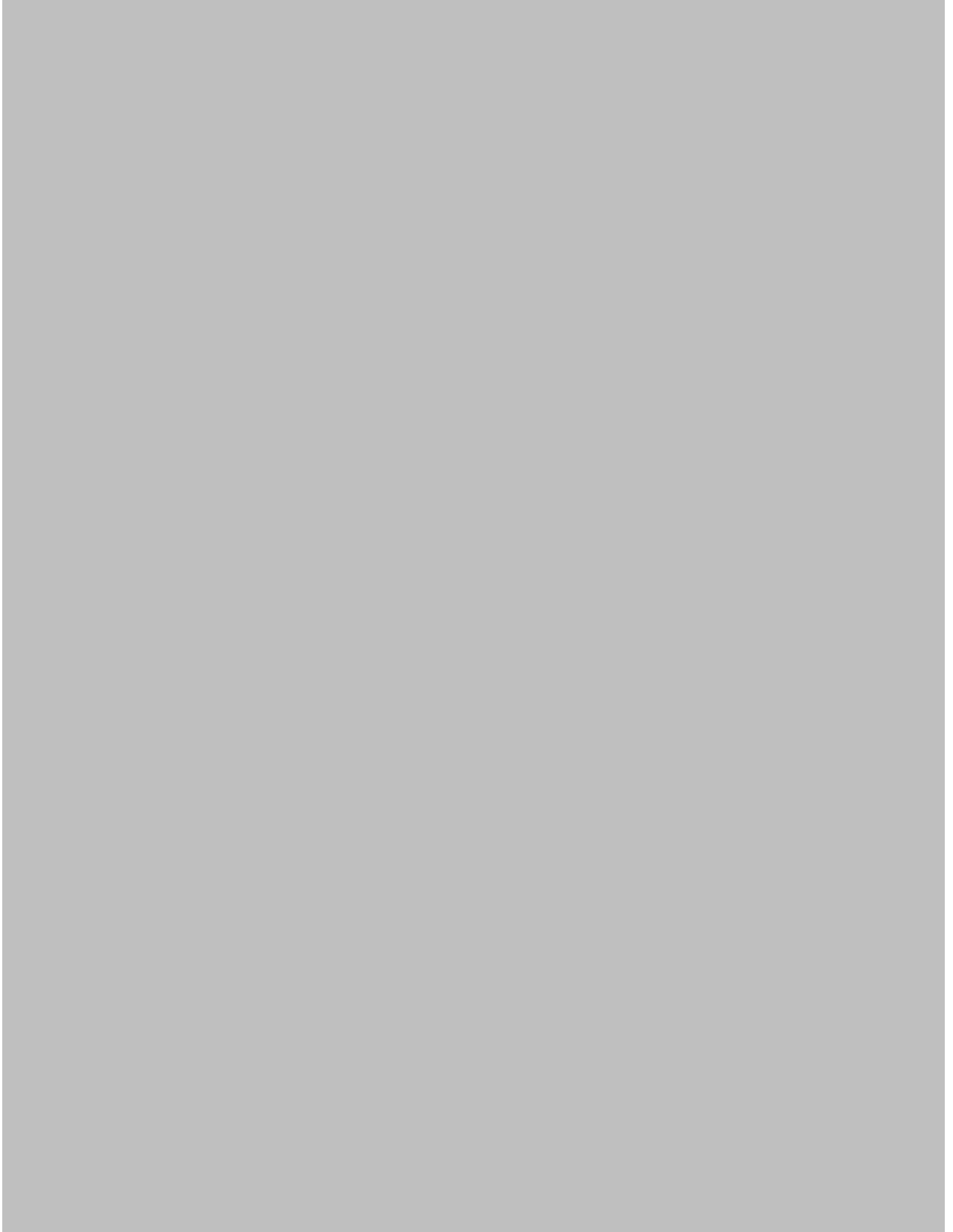
If yes please list

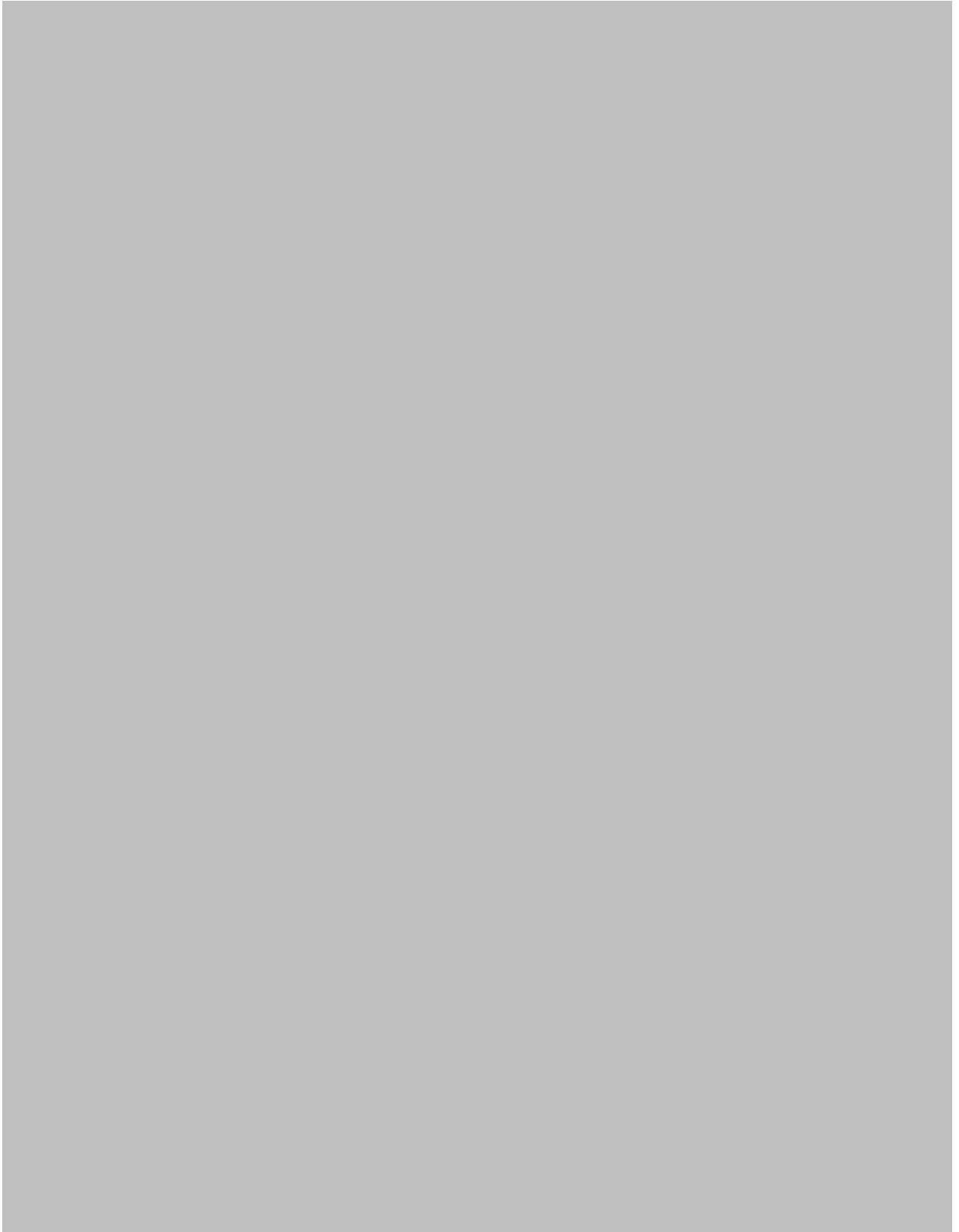
Thank you very much for taking the time to complete this questionnaire

Appendix 7- Patient Health Questionnaire (PHQ-9)



Appendix 8 – Diabetes Distress Scale (DDS)





Appendix 9 - SPSS output for descriptive statistical analysis

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	21.0000	26.0000	69.0000	53.2857	12.2153
N_DM_Years	21.0000	2.0000	36.0000	16.5238	10.0877
BMI	21.0000	19.6330	51.4772	31.1782	8.4104
PHQ-9 Total	21.0000	.0000	16.0000	7.1429	5.4248
DDS Total	21.0000	20.0000	68.0000	32.9524	13.0556
Mean Item Score	21.0000	1.1765	4.0000	1.9384	.7680
WTAR FSIQ	21.0000	75.0000	110.0000	100.3333	8.8619
RAVLT T I	21.0000	-2.0000	3.0000	-.0973	1.3508
RAVLT T VI	21.0000	-1.4828	1.8214	.4341	1.0627
Switch	21.0000	1.0000	12.0000	8.1905	2.2939
HbA1c Percentage	21.0000	6.4000	10.5000	8.1810	1.0856
Blood Glucose	21.0000	4.0000	13.9000	9.0571	2.6964
Valid N (listwise)	21.0000				

Frequency Tables

Gender

	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Male	10	47.6	47.6	47.6
Valid Female	11	52.4	52.4	100.0
Total	21	100.0	100.0	

Type of Diabetes

	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Type 1	7	33.3	33.3	33.3
Type 2	14	66.7	66.7	100.0
Total	21	100.0	100.0	

Ethnicity

	Frequency	%	Valid %	Cumulative %
White	16	76.2	76.2	76.2
Asian or]	4	19.0	19.0	95.2
British Asian				
Black or	1	4.8	4.8	100.0
Black British				
Total	21	100.0	100.0	

Marital Status

	Frequency	%	Valid %	Cumulative %
Single	1	4.8	4.8	4.8
Co-habiting	2	9.5	9.5	14.3
Married	16	76.2	76.2	90.5
Divorced	2	9.5	9.5	100.0

Total	21	100.0	100.0
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Education

	Frequency	%	Valid %	Cumulative %
Secondary School	10	47.6	47.6	47.6
College	6	28.6	28.6	76.2
Valid University/	5	23.8	23.8	100.0
Professional				
Total	21	100.0	100.0	

Employment

	Frequency	%	Valid %	Cumulative %
Full Time Student	1	4.8	4.8	4.8
Full Time Employed	5	23.8	23.8	28.6
Part Time Employed	3	14.3	14.3	42.9
Valid Self Employed	1	4.8	4.8	47.6
Not Employed	4	19.0	19.0	66.7
Retired	7	33.3	33.3	100.0
Total	21	100.0	100.0	

Self - reported current depression (from demographic information sheet)

	Frequency	%	Valid %	Cumulative %
No	20	95.2	95.2	95.2
Valid Yes	1	4.8	4.8	100.0
Total	21	100.0	100.0	

Self - reported past depression (from demographic information sheet)

	Frequency	%	Valid %	Cumulative %
No	16	76.2	76.2	76.2
Valid Yes	5	23.8	23.8	100.0
Total	21	100.0	100.0	

PHQ 9 category (based on scoring method)

	Frequency	%	Valid %	Cumulative %
Min. (0-4)	9	42.9	42.9	42.9
Mild (5-9)	5	23.8	23.8	66.7
Mod.(10-14)	5	23.8	23.8	90.5

Mod. Sev.(15-20)	2	9.5	9.5	100.0
Sev	0	0	0	100.0
Total	21	100.0	100.0	

Diabetes Distress Scale (DDS) Mean Item Score 3 or more

	Frequency	%	Valid %	Cumulative %
DDS Mean Item Score l<3	18	85.7	85.7	85.7
DDS Mean Item Score 3 or greater	3	14.3	14.3	100.0
Total	21	100.0	100.0	

Appendix 10 - SPSS output for correlation analysis

Correlations

		Age	BMI	Blood Glucose	HbA1c %	WTAR FSIQ	RAVLT I	RAVLT VI	PRLT Switchs
Age	Pearson Correlation	1	.147	.212	-.072	.219	.112	-.141	.010
	Sig. (2-tailed)		.524	.355	.758	.339	.629	.543	.964
	N	21	21	21	21	21	21	21	21
BMI	Pearson Correlation	.147	1	-.243	.311	-.157	-.426	-.012	.004
	Sig. (2-tailed)	.524		.289	.170	.498	.054	.958	.986
	N	21	21	21	21	21	21	21	21
Blood Glucose	Pearson Correlation	.212	-.243	1	-.034	.215	.264	-.045	.094
	Sig. (2-tailed)	.355	.289		.884	.350	.248	.846	.684
	N	21	21	21	21	21	21	21	21
HbA1c %	Pearson Correlation	-.072	.311	-.034	1	-.220	-.334	-.251	-.171
	Sig. (2-tailed)	.758	.170	.884		.339	.139	.273	.458
	N	21	21	21	21	21	21	21	21
WTAR FSIQ	Pearson Correlation	.219	-.157	.215	-.220	1	.492 [*]	.491 [*]	.280
	Sig. (2-tailed)	.339	.498	.350	.339		.024	.024	.220
	N	21	21	21	21	21	21	21	21
RAVLT I	Pearson Correlation	.112	-.426	.264	-.334	.492 [*]	1	.512 [*]	.251
	Sig. (2-tailed)	.629	.054	.248	.139	.024		.018	.272
	N	21	21	21	21	21	21	21	21
RAVLT VI	Pearson Correlation	-.141	-.012	-.045	-.251	.491 [*]	.512 [*]	1	.357
	Sig. (2-tailed)	.543	.958	.846	.273	.024	.018		.112
	N	21	21	21	21	21	21	21	21
PRLT Switches	Pearson Correlation	.010	.004	.094	-.171	.280	.251	.357	1
	Sig. (2-tailed)	.964	.986	.684	.458	.220	.272	.112	
	N	21	21	21	21	21	21	21	21

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix 11 – Mediation Analysis Output

Run MATRIX procedure:

***** PROCESS Procedure for SPSS Release 2.11 *****

Written by Andrew F. Hayes, Ph.D. www.afhayes.com
Documentation available in Hayes (2013). www.guilford.com/p/hayes3

Model = 4
Y = ZPHQ9Tot
X = ZDDSTot
M = ZSwitch

Sample size
21

Outcome: ZSwitch

Model Summary

R	R-sq	F	df1	df2	p
.0554	.0031	.0585	1.0000	19.0000	.8114

Model

	coeff	se	t	p	LLCI	ULCI
constant	.0000	.2235	.0000	1.0000	-.4679	.4679
ZDDSTot	.0554	.2291	.2419	.8114	-.4241	.5349

Outcome: ZPHQ9Tot

Model Summary

R	R-sq	F	df1	df2	p
.3439	.1182	1.2069	2.0000	18.0000	.3222

Model

	coeff	se	t	p	LLCI	ULCI
constant	.0000	.2160	.0000	1.0000	-.4538	.4538
ZSwitch	.1044	.2217	.4711	.6432	-.3613	.5702
ZDDSTot	.3219	.2217	1.4521	.1637	-.1439	.7876

***** TOTAL EFFECT MODEL *****

Outcome: ZPHQ9Tot

Model Summary

R	R-sq	F	df1	df2	p
.3277	.1074	2.2854	1.0000	19.0000	.1470

Model

	coeff	se	t	p	LLCI	ULCI
constant	.0000	.2115	.0000	1.0000	-.4428	.4428
ZDDSTot	.3277	.2167	1.5118	.1470	-.1260	.7814

***** TOTAL, DIRECT, AND INDIRECT EFFECTS *****

Total effect of X on Y

Effect	SE	t	p	LLCI	ULCI
.3277	.2167	1.5118	.1470	-.1260	.7814

Direct effect of X on Y

Effect	SE	t	p	LLCI	ULCI
.3219	.2217	1.4521	.1637	-.1439	.7876

Indirect effect of X on Y

	Effect	Boot SE	BootLLCI	BootULCI
ZSwitch	.0058	.0688	-.0671	.2157

***** ANALYSIS NOTES AND WARNINGS *****

Appendix 12 – Instructions for Authors

