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Title: A new measure of multimorbid illness and treatment representations: The example of diabetes and depression

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Abstract

Background

Depression is two to three times more common in people with diabetes than in the general population. Although multimorbid diabetes and depression is associated with poor health outcome, existing research has focused on patients' understanding and management of each condition in isolation. This study describes the development and validation of the Diabetes and Depression Representation and Management Questionnaire (DDRMQ), a measure of understanding, management and medication beliefs in people with diabetes and depression.

Methods

In Study 1, DDRMQ items were developed through further analysis of an earlier qualitative study and refined through 18 cognitive interviews. In Study 2, 334 adults with diabetes and depression from general practices, diabetes clinics and support groups completed the DDRMQ, demographic questions and validating measures.

Results

Factor analysis of the DDRMQ using principal axis factoring resulted in a 35 item scale organised into ten subscales. The modified measure had adequate internal and test-retest reliability. Initial evidence of construct validity was also demonstrated.

Limitations

Low participant response rates and the high percentage of well-educated white participants limit the generalizability of results. As Study 2 was cross-sectional future research is needed to establish if different ways of thinking about and managing diabetes and depression can predict patient outcome.

Conclusions

The DDRMQ is the first measure of patient understanding, management and medication beliefs in people with established diagnoses of both diabetes and depression. The DDRMQ will facilitate an increased awareness of the patient experience of diabetes and depression and help inform patient centred care and intervention development for people with multiple conditions.

Key words

Diabetes; Depression; Illness Beliefs; Multimorbidity; Questionnaire; Self-Management

Introduction

Depression is three times more common in people with Type 1 Diabetes Mellitus (T1DM) and twice as common in people with Type 2 Diabetes Mellitus (T2DM) than in the general population (Roy and Lloyd, 2012). Diabetes and depression are major health problems that in combination result in poor health outcome. Depression in diabetes is associated with a higher prevalence of diabetes complications (De Groot et al., 2001), and increased mortality (Katon et al., 2005). In addition, having both diabetes and depression is associated with reduced quality of life (Schram et al., 2009) and higher healthcare costs than either condition alone (Renn et al., 2011).

There is a bi-directional relationship between diabetes and depression; people with depression are at an increased risk of developing T2DM (Mezuk et al., 2008) and people with diabetes are at increased risk of depression (Nouwen et al., 2010). The diabetes-depression relationship is a source of research interest as evidenced by a supplement to the Journal of Affective Disorders produced by the Dialogue on Diabetes and Depression in 2012.

Alongside articles on epidemiological (Roy and Lloyd, 2012), cross-cultural (Lloyd et al., 2012) and economic (Molosankwe et al., 2012) issues the supplement included a review by Fisher and colleagues which outlined different ways of conceptualising diabetes and depression, for example as an integrated combination versus two distinct clinical conditions (Fisher et al., 2012).

One element not addressed by Fisher et al. (2012), and lacking in the literature in general, is an exploration of patients' understanding of having both diabetes and depression. A model frequently used to explain how patients understand and manage their health is the Common Sense Model of Health and Illness (CSM: Leventhal et al., 1980). According to the CSM,

individuals carry out checks comparing current functioning with normal expected functioning. If a deviation is identified common-sense understandings of the health threat, or illness representations, are developed. These representations inform the selection of procedures to manage the health threat and restore normal functioning. For people with chronic illness, common sense procedures include treatment-seeking and self-management (Leventhal et al., 2011).

Illness representations have been grouped into dimensions of Cause, Coherence, Consequence, Cure-control, Identity and Timeline (Leventhal et al., 2011, Moss-Morris et al., 2002) and previous research has demonstrated the impact of illness representations on self-management, healthcare interactions, and outcome (Hagger and Orbell, 2005, Petrie and Weinman, 2006). For example, negative representations of a current health condition (e.g. serious consequences and a longer timeline) have been shown to be associated with future healthcare use, independent of doctors' severity rating and previous use of healthcare (Frostholm et al., 2005). The CSM has also been extended to include beliefs about treatment with evidence that medication adherence is associated with beliefs about general medication harm and overuse and need for and concern about specific medications (Horne et al., 1999).

Validated questionnaires have been developed to measure illness and treatment representations of diabetes and depression separately (e.g. Moss-Morris et al., 2002, Lynch et al., 2011) and have been used to demonstrate an association between diabetes representations and glycated haemoglobin (HbA_{1c}) an objective measure of blood glucose control (Mc Sharry et al., 2011). There is also a body of literature describing the assessment of the emotional aspects of living with diabetes through widely used and validated measures such as the Problem Areas in Diabetes scale (Polonsky et al., 1995) and the Diabetes Distress Scale (Polonsky et al., 2005). However, these measures focus on emotional response to diabetes,

including physician and regimen related distress and emotional burden, rather than on diabetes and depression as two separate but related conditions. Very little research has looked at patients' representations of having both diabetes and depression at the same time and the potential interactions with patient behaviours, treatment preferences or outcome.

Recent qualitative work has begun to address this gap in the literature (Mc Sharry et al., 2013, Bower et al., 2011). One study conducted with 17 primary care patients demonstrated that even people with similar illness trajectories may differ in their representation and management of diabetes and depression (Mc Sharry et al., 2013). Between-patient differences in representations of diabetes and depression may impact on preferred self-management styles and interactions with healthcare professionals. A person who sees their depression as a symptom of their diabetes, for example, may have different care priorities from someone who sees diabetes and depression as separate unrelated conditions (Mc Sharry et al., 2013). Concordance in understandings between patients and healthcare professionals may also be important with evidence from the single condition literature demonstrating higher physician accuracy in understanding patients' diabetes representations to be associated with better self-care behaviours (Sultan et al., 2011).

Further systematic exploration of potential differences in patients' illness and treatment representations of diabetes and depression and the investigation of whether these representations are associated with outcome will require the use of a psychometrically sound measurement tool. The overall aim of the present study was to develop a reliable and valid questionnaire to measure illness representations, self-management and medication beliefs in people with both diabetes and depression. This aim was broken down into two objectives addressed in two studies. The first objective was to develop questionnaire items to measure

illness representations, reported self-management and medication beliefs in people with diabetes and depression and to establish the face validity and ease of comprehension of items through cognitive interviews (Study 1). The second objective was to examine the factor structure and psychometric properties of the new questionnaire with a sample of people with diabetes and depression (Study 2).

Study 1 Questionnaire Development

Objective

To develop questionnaire items to measure illness representations, self-management and medication beliefs in people with diabetes and depression and to explore the face validity and ease of comprehension of items.

Study 1 Methods

Questionnaire Development

Given the lack of existing research in this area, qualitative interviews with 17 people with diabetes and depression were the main source of questionnaire item generation (Mc Sharry et al., 2013). The qualitative interviews informed item development in two ways. First the inductive analysis of the interviews led to the development of a conceptual model used as the framework for questionnaire items (Figure 1). While some people see diabetes and depression as unrelated and manage each separately, others see interactions between the conditions and link their management of diabetes and depression. Patients may also differ in the coherence of their understanding of the diabetes and depression relationship and experience problems managing multiple medication regimes at once. Accordingly, three main domains, *Diabetes and Depression Relationship*, *Diabetes and Depression Self-Management*

and *Multiple Medication Issues* were identified from the conceptual model for inclusion in the questionnaire.

Insert Figure 1 around here

Second, the interviews were used to identify words and phrases for questionnaire items to ensure items reflected patients' own language. Interview transcripts were re-analysed deductively using the three domains identified from the conceptual model as the basis of the coding framework (Braun and Clarke, 2006). These three domains were further divided into sub-categories during the deductive analysis. *Diabetes and Depression Relationship* was divided into sub-categories of *Illness Priority*, *Representation Coherence*, *Separate Representations* and *Linked Representations*. *Diabetes and Depression Self-Management* was divided into sub-categories of *Separate Management* and *Linked Management*. *Multiple Medication Issues* was divided into sub-categories of *General*, *Specific Diabetes* and *Specific Depression*. Relevant existing measures of single condition illness representations and medication beliefs also informed the development of items within these sub-categories (Moss-Morris et al., 2002, Horne et al., 1999).

Relevant existing measures of single condition illness representations and medication beliefs also informed the development of items. *Representation Coherence*, or patients' confidence in their understanding of relationships between multiple illnesses, has not previously been measured. However a similar concept, illness coherence, has been measured in single conditions as part of the IPQ-R (Moss-Morris et al., 2002). Consequently, three items from the IPQ-R illness coherence subscale were included to reflect *Representation Coherence*, together with two newly developed items.

Medication beliefs have previously been measured within a CSM framework by the Belief about Medications Questionnaire (BMQ), a validated 18 item measure of patients' representation of medication (Horne et al., 1999). The BMQ consists of two sections; the BMQ-General which assesses general medication beliefs and the BMQ-Specific which assesses patients' perceptions of the need for and concern about their own prescribed medicines. Two BMQ-General items (My medicines are a mystery to me, My medicines disrupt my life) were included to reflect *Multiple Medication Issues-General* alongside new items developed to assess respondents' medication knowledge and the perceived burden and harm associated with taking multiple medications. BMQ Specific need and concern items related to both diabetes and depression were also included to reflect the *Multiple Medication Issues-Specific* category together with new items measuring perceived negative effects of medication for one condition on the other and perceptions of whether taking medications for each condition was natural.

A five point Likert response scale with response options appropriately matched to questions was used (Likert, 1932, Streiner and Norman, 2008). Agreement Likert response options were chosen for belief and attitude items under the representation and medication domains ranging from 1 (Strongly Disagree) to 3 (Neither Agree nor Disagree) to 5 (Strongly Agree). As management items measured self-reported behaviour, the Likert scale used for these items ranged from 1 (Never) to 3 (Some of the Time) to 5 (Always). In addition, two categorical items were developed to assess priority placed on diabetes, depression or other conditions.

To assess the face and content validity of the developed items known experts in the field, including diabetes and depression researchers, multimorbidity researchers and a diabetes nurse specialist, were contacted for feedback and their suggestions incorporated. This process

resulted in a pool of 83 items which was called the Diabetes and Depression Representation and Management Questionnaire (DDRMQ). A cognitive interviewing study was then conducted to further refine the developed items.

Participants and Procedure

Adults with diabetes and depression were recruited from support groups Diabetes UK, Diabetes Research and Wellness Foundation and Depression UK. Maximum variation sampling was used to identify people expected to vary on the concepts of interest to allow questionnaire items to be tested with the most diverse sample possible (Patton, 1990).

Potential participants were asked demographic questions and selected based on differences in gender, age, work status, educational background, presence of additional conditions and time of diagnosis of diabetes and depression.

Cognitive interviewing consists of the administration of draft questionnaire items while collecting verbal information on the cognitive processes used to select a response. Cognitive interviews were conducted by the first author, either face to face or over the phone, to explore if items were understood as intended and to test items for relevance and lack of ambiguity. Participants were asked to read through the questionnaire items and to ‘think aloud’ their thoughts as they decided on their response (Willis, 2005). Verbal probing techniques were also used to request information relevant to particular items or responses. Participants interviewed over the phone were sent a draft version of the DDRMQ in a sealed envelope and asked to open the questionnaire during the phone call. This procedure allowed for the cognitive interviews to assess participants’ first reaction to questionnaire items. The interviews were audio- taped, transcribed verbatim and analysed by the first author following the guidance of Willis (2005).

Ethical Approval

The study received ethical approval from the School of Psychology, University of Southampton Research Governance Committee (ref: 727). All participants gave informed consent before taking part.

Study 1 Results

Eighteen people (7 men and 11 women) took part in the interviews. Participants were aged between 20 and 75 years and 11 had T1DM. The sample varied in age, gender, diagnosis pattern and depression severity but the entire sample self-identified as White British. The interviews lasted between 37 and 110 minutes with a mean duration of 59 minutes.

Following the cognitive interviewing analysis 29 items were kept, 35 items were modified and 19 items were deleted. Items were modified to increase clarity and deleted if found to be difficult to understand, ambiguous or repetitive. Five new items were added following suggestions by participants. The modified DDRMQ consisted of 72 items.

A major issue identified during cognitive interviews was the use of the word “depression” versus terms such as “feeling down”, “miserable” or “feel low”. Participants’ think-aloud explanations of their responses indicated that the different terms altered their approach to answering items. Some participants saw clear differences between these terms and described them as referring to varying levels of low mood. Others responded as if all of these terms were the same.

Differences between respondents in item interpretation may result in questionnaire scores that reflect differences in item understanding rather than variations on the construct of interest.

The decision to use the word depression exclusively was debated within the project team as it

could result in problems for people who did not identify with the term depression, despite being diagnosed or treated for depression. However, as the subsequent validation study was to be advertised using the term depression it is likely that people who did not affiliate themselves with the word would not take part in the study. Consequently the term depression was used consistently throughout the questionnaire.

Study 2 Questionnaire Validation

Objective

To examine the factor structure and psychometric properties of the DDRMQ with a sample of people with diabetes and depression.

Study 2 Methods

Participants and Procedure

Adults with T1DM or T2DM and a current or previous diagnosis of depression were included. Participants were recruited from primary care practices, diabetes clinics and support groups. Fifteen volunteer primary care practices from the south of England sent questionnaire packs to eligible adults identified from the computerised disease registers. Diabetes nurses and consultants at University Southampton Hospital NHS Foundation Trust also identified eligible patients attending clinics. Diabetes UK, Diabetes Research and Wellness Foundation, Diabetes Support UK and Depression UK advertised the study to their members.

Participants could return a paper copy of the completed questionnaire pack or complete the questionnaires online through iSurvey, a secure questionnaire tool available at the University of Southampton. A sub-sample of participants was asked to complete the DDRMQ for a

second time two weeks after original testing to provide an estimate of test-retest reliability or consistency in questionnaire responses over time. The sample of participants who completed the DDRMQ for a second time did not differ from the remainder of the sample in terms of gender, presence of additional conditions, or self-reported health status. The test re-test sub-sample did, however, include more participants in the older age categories than the rest of the sample. All participants were entered into a draw to win a £100 gift voucher.

Ethical Approval

The study received ethical approval from the National Research Ethics Service, South Central Research Ethics Committee (ref: 11/SC/0357) and the School of Psychology, University of Southampton Research Governance Committee (ref: 627). All participants gave informed consent before taking part.

Measures

Questionnaire packs, and the online questionnaire site, included a participant information sheet, consent form and the following measures:

i) Demographic Questionnaire

Ten questions on age, gender, ethnicity, education level, occupational status, marital status, diabetes type, time since diagnosis of diabetes and depression, most recent HbA_{1c} result and information on other conditions.

ii) Diabetes and Depression Representation and Management Questionnaire (DDRMQ)

A 72 item measure of diabetes and depression representations, self-management and beliefs about multiple medications as described above.

iii) Self-reported Health Measure

An item assessing patients' overall self-reported health status on a 5-point scale (Very Good, Good, Fair, Bad, Very Bad) taken from the Health Survey for England (2010). This item was used to assess construct validity by calculating associations between DDRMQ subscales and perceived health status.

iv) The Hospital Anxiety and Depression Scale (HADS)

A 14 item measure of anxiety and depression comprised of two seven item subscales, one measuring depressive symptoms (HADS-D) and one measuring anxiety symptoms (HADS-A) during the past seven days (Zigmond and Snaith, 1983). Items are scored from zero to three and total scores on each subscale range from 0-21. In a systematic review a cut-off point of 8/21 per subscale was identified as indicative of possible anxiety or major depression (Bjelland et al., 2002). The HADS was chosen as it is a short measure that does not assess the somatic symptoms of depression which share potential overlap with diabetes symptomology (Roy et al., 2012). In addition, systematic review evidence has demonstrated that the HADS performs well in assessing the symptom severity and caseness of depression in primary care patients and in the general population (Bjelland et al., 2002). The HADS-D subscale was used in the current study to assess construct validity by calculating associations between DDRMQ subscales and total HADS-D scores.

v) The Morisky Medication Adherence Questionnaire (MMAS-8)

An eight item measure of adherence to medication (Morisky et al., 2008). MMAS-8 reliability and validity has been demonstrated in a range of illnesses (Morisky et al., 2008). The MMAS-8 was administered separately for diabetes medication and depression medication. The MMAS-8 was included to assess construct validity

by calculating associations between DDRMQ subscales and medication adherence.

Sample Size

A large literature has discussed the minimum sample sizes needed to assess the factor structure of a scale. Recommendations generally fall into two categories: the minimum required sample size or the subject-to-item ratio (Field, 2009). Despite the wide variety of recommendations, general rules of thumb may not always be appropriate as adequate sample size is partly determined by the nature of the data (MacCallum et al., 1999). Although larger samples tend to produce solutions that are more accurate, stronger data can result in accurate analyses with smaller samples (Costello & Osborne, 2005). As the nature of the data could not be determined in advance, a minimum sample size of 300 was selected for this study. Samples of 300 have been described as generally sufficient for a stable factor solution (Field, 2009). When conducting the analysis, the Kaiser-Meyer-Olkin (KMO) statistic was calculated as a measure of sampling adequacy for each analysis. The value of KMO should be greater than 0.50 if the sampling is adequate, the KMO measure ranged from 0.64 – 0.89 for the analyses conducted (Field, 2009).

Analysis

All data were entered into SPSS (version 20) for analysis. To assess the accuracy of data entry, 10% of data were double entered; minimal discrepancies were identified. Missing data were deleted listwise for factor analysis. Using the criteria described by Benson and Vincent (1980) to identify redundant items, items were deleted if one of the response categories was used by greater than 50% of respondents or if two of the five response categories were used by fewer than 10% of respondents.

Exploratory Factor Analysis

An exploratory factor analysis using Principle Axis Factoring (PAF) extraction and direct oblimin rotation was conducted (Fabrigar et al., 1999, Costello and Osborne, 2005). PAF extraction was used as the DDRMQ data appeared to be non-normally distributed; PAF has been recommended for use with non-normally distributed data (Fabrigar et al., 1999; Costello & Osborne, 2005). Solution rotation was conducted as it can simplify and clarify data structure and aid with interpretation. Direct oblimin oblique rotation rather than an orthogonal rotation was conducted as it was anticipated that some DDRMQ variables would be correlated (Costello & Osborne, 2005).

The Kaiser criterion, the retention of factors with eigenvalues greater than one, was initially used to identify potential factors. The scree test was then used to verify the best factor solution (Gorsuch, 1983). Items with loadings of greater than 0.55 onto one factor and less than 0.45 on any other factor were retained as good measures of a factor; loadings of 0.55 indicate that an item has 30% overlapping variance with the factor (Comrey and Lee, 1992). Items not meeting these criteria were removed and the data re-analysed to achieve the maximum amount of variance explained by the minimum number of items. Overall, the fewest items were retained which produced interpretable factors with adequate internal consistency. A minimum of three items per factor was set as factors with fewer than three items may be unstable (Costello & Osborne, 2005).

A series of five PAF analyses were conducted. Twenty items relating to diabetes and depression representations (including items intended to measure overall representation coherence) were analysed separately from the 15 items related to self-management due to the different measurement scales used (Moss-Morris et al., 2002). Items assessing general,

diabetes, and depression medication beliefs were also analysed separately given the differing numbers of respondents who took medications for the different conditions. The Kaiser-Meyer-Olkin statistic was calculated as a measure of sampling adequacy for each analysis. Two categorical items assessed illness priority and were not entered into the factor analysis.

Reliability

Cronbach's alpha was calculated as a measure of the internal reliability of the DDRMQ subscales developed following the exploratory factor analysis. Scores on negatively worded items were reversed prior to the calculation of internal consistency (Field, 2009). Values of 0.7 and above are generally considered acceptable for psychological constructs (Field, 2009). Test-retest reliability was calculated using Spearman's rho correlations between DDRMQ scores at initial completion and two weeks later. Test-retest reliability scores of greater than 0.5 have been described as a reasonable minimum (Streiner & Norman, 2003).

Construct Validity

Based on the conceptual model shown in Figure 1, positive associations between viewing diabetes and depression as separate and managing diabetes and depression separately, and between making links between diabetes and depression and reporting managing both conditions together were expected. It was also hypothesised that representations of diabetes and depression as separate would be negatively correlated with seeing them as linked.

Detweiler-Bedell et al. (2008) suggested that an understanding of condition interaction is required for patients to optimise management of multiple conditions. Consequently, it was expected that reporting integrating the management of diabetes and depression would be associated with positive health outcome in terms of self-reported health, HADS-D depression severity and HbA_{1c}. Conversely, reporting struggling to manage diabetes and depression at

the same time was predicted to be associated with negative health outcome. Finally, it was anticipated that negative general medication beliefs and negative diabetes and depression specific medication beliefs would be associated with poorer adherence to medication as measured by the MMAS-8 (Morisky et al., 2008).

Subscale totals were computed by reversing relevant items and summing scores on the items that loaded onto each factor identified during the PAF analyses. Spearman's rho correlations using DDRMQ total scores were conducted to test hypothesised associations.

Study 2 Results

Participants

Three hundred and thirty four participants took part in the study. One hundred and eight (32%) participants were recruited through GP practices, eight (2%) from diabetes clinics and 218 (65%) from support groups. A response rate of 19% was obtained from GP practices. Information on response rates from support groups could not be calculated as study adverts could have been viewed online by any number of people.

As shown in Table 1, the majority of the sample was White (95%), 229 (68.6%) were female and the sample ranged in age marital status and occupation. Respondents were highly educated with 26% having completed university and 13% having completed post-graduate study. Over half of the sample (59%) had additional other conditions. The majority of the sample rated their health as good (43%) or fair (36%).

One hundred and seventy seven participants (53%) had T2DM, 143 (43%) had T1DM and eight were unsure. The median HbA_{1c} level was 8.3% (SD 2.1) (67 mmol/mol) for participants with T1DM and 7.2% (SD 2.4) (55 mmol/mol) for participants with T2DM.

Two hundred and thirteen respondents (63.8%) scored eight or greater on the HADS indicating possible major depression (Bjelland et al, 2002).

Insert Table 1 around here

Exploratory Factor Analysis

Eleven items were identified as redundant using the Benson and Vincent (1980) criteria and were deleted prior to factor analysis. A series of five PAF analyses were then conducted to assess the factor structure of the DDRMQ. The results of the PAF analyses for the relationship between diabetes and depression, self-management of diabetes and depression and general medication beliefs are shown in Tables 2 to 4.

Insert Tables 2 to 4 around here

PAF of diabetes and depression medication items resulted in two single factor three item solutions labelled *Diabetes Medication Worry* (Having to take diabetes medicines worries me; I sometimes worry about the long-term effects of my diabetes medicines; I sometimes worry about becoming too dependent on my diabetes medicines) and *Depression Medication Worry* (I sometimes worry about the long-term effects of my depression medicines; I sometimes worry about becoming too dependent on my depression medication; It's not natural to take medication to manage my depression) explaining 75.4% and 60.2% of the variance respectively.

Following exploratory factor analysis the modified DDRMQ comprised of 35 items organized into 10 subscales: *Separate Representations*, *Negative Linked Representations*, *Incoherent Representations*, *Separate Management*, *Linked Management Integration*, *Linked*

Management Struggle, General Medication Negative Effects, General Medication Burden Diabetes Medication Worry and Depression Medication Worry (See Appendix 1).

Reliability

All subscales demonstrated good internal consistency in this population with scores ranging from 0.70 to 0.86. One hundred and thirty five adults completed the DDRMQ after two weeks in order to assess the test-retest reliability of the measure. DDRMQ dimensions showed generally adequate stability over this period with Spearman's rho correlations ranging from 0.57 to 0.82. There were also no significant differences between subscale total scores at each time point based on a series of Wilcoxon signed-ranks tests. Internal consistency and test-retest reliability results are shown in Table 5.

Insert Table 5 around here

Construct Validity

Separate Representations scores were positively correlated with higher *Separate Management* scores ($r = 0.42$, $n = 317$, $p < 0.01$). Similarly, scores on the *Negative Linked Representations* subscale were positively correlated with *Linked Management Struggle* scores ($r = 0.61$, $n = 316$, $p < 0.01$). *Separate Representations* scores were negatively correlated with *Negative Linked Representations* scores ($r = -0.47$, $n = 321$, $p < 0.01$).

Higher *Linked Management Integration* scores have a small positive association with higher self-rated health ($r = 0.14$, $n = 321$, $p < 0.01$) but not with HADS-D scores or HbA_{1c} levels. Higher *Linked Management Struggle* scores were negatively correlated with self-rated health ($r = -0.24$, $n = 313$, $p < 0.01$) and positively correlated with HADS-D scores ($r = .34$, $n = 307$, $p < 0.01$) and HbA_{1c} levels ($r = 0.32$, $n = 135$, $p < 0.01$) as hypothesised.

As expected higher *General Medication Negative Effect* was negatively correlated with MMAS-8 Diabetes ($r = -0.27, n = 255, p < 0.01$) and MMAS-8 Depression medication adherence scores ($r = -0.15, n = 215, p < 0.01$), *Diabetes Medication Worry* was negatively correlated with diabetes medication adherence ($r = -0.30, n = 261, p < 0.01$) and *Depression Medication Worry* scores was negatively correlated with depression medication adherence ($r = -0.23, n = 228, p < 0.01$).

Discussion

Factor analysis of the DDRMQ resulted in the retention of 35 items organised into ten subscales related to representations of the relationship between diabetes and depression, reported self-management and general and condition specific medication beliefs. Some of the groups of items originally developed did not differentiate well between individuals.

Medication Knowledge, *Diabetes Medication Need* and *Depression Medication Need* items were deleted prior to factor analysis as participants uniformly reported good knowledge of their medications and a need for medication for both conditions. In addition items retained in relation to perceived links between diabetes and depression all described an adverse impact of one condition on the other. Consequently, this subscale was named *Negative Linked Representations* as an indication of the negative relationships perceived between the two conditions.

The DDRMQ appeared to be a reliable measure in the sample population with acceptable levels of internal consistency and test-retest reliability. DDRMQ subscales inter-correlations were as expected providing evidence of construct validity. There was also initial evidence of a relationship between DDRMQ subscales and outcome through the association of *Linked Management* with greater self-rated health and *Linked Management Struggle* with higher

depression scores and poorer blood glucose control and self-rated health. The associations of *General Medication Negative Effect*, *Diabetes Medication Worry* and *Depression Medication Worry* with non-adherence to medication also indicate a potential role for the DDRMQ in explaining why patients with diabetes and depression may not always take medication as prescribed.

Strengths and Limitations

The DDRMQ represents a novel attempt to develop a measure of the patient perspective of diabetes and depression. DDRMQ items were developed logically from a conceptual model identified through qualitative work with the target population and modified and refined through a rigorous cognitive interviewing process. Three hundred and thirty four respondents were recruited in Study 2 ensuring an adequate sample for factor analysis and decisions made in testing the factor structure, reliability and validity of the measure were clearly outlined for transparency.

The generalisability of the findings of Study 2 is limited by the potential for response bias and lack of representativeness of the final sample. The response rate was not identifiable for participants who completed the questionnaires online but the response rate among GP practices was quite low at 19%. In the absence of data on non-respondents the representativeness of the respondents cannot be assessed. The sample was, however, well-educated and predominantly White. Previous published work of responding in patients with mental health conditions found non-respondents more likely to be male, in a lower socio-economic group, unmarried and from a minority ethnic group and is possible that the results of this study are biased in a similar way (Fischer, Dornelas, & Goethe, 2001).

In addition, the included participants may have had a greater interest in their health than the general population. This is an on-going difficulty in research as the characteristics of individuals who sign up for research studies may differ from those who do not participate. The use of support group populations may also have been a source of bias and the current study may have included a disproportionate number of engaged patients with well-formulated ideas about their multimorbidity.

People with both T1DM and T2DM were included as a homogenous group although beliefs about illness may differ across the two types of diabetes. Similarly, depression is a multi-faceted concept made up of overlapping cognitive, behavioural and affective elements and the relationship of each of these aspects with diabetes was not unravelled. Instead, a narrow operationalisation of depression as a named condition distinguishable through a GP diagnosis or self-identification with the term was adopted. As a result, the current study did not explore alternative ways to conceptualise depressive symptoms in diabetes. The use of the word depression may also have had an impact on response as some individuals may not reply to an advert clearly using the term.

Implications for Research and Practice

Our findings suggest it is possible to differentiate between individuals with diabetes and depression based on their illness representations and management beliefs and that these dimensions can be measured quantitatively using the DDRMQ. The DDRMQ is intended for use by clinicians and researchers with people with established diagnoses of both diabetes and depression, to explore their understanding and management of both conditions and to monitor changes in representation over time.

Much of healthcare is targeted to single conditions in isolation although this is not the reality for many patients. The DDRMQ has the potential to inform new approaches to health care by facilitating the patient centred approach to multiple conditions advocated by experts in the field (Caughey and Roughead, 2011). The DDRMQ could be used to facilitate a discussion about managing diabetes and depression during clinical consultations and to help elicit patient preferences for self-management to enable joint decision-making. Given the growing healthcare challenge to address patient concerns within a time-limited consultation, the use of simple questions in the DDRMQ could provide an important first step in identifying patients' priorities for care.

From a research perspective the DDRMQ extends the CSM literature, in particular the concept of illness identity, through the measurement of patients' perceptions of the relationship between conditions. Viewing conditions as related or unrelated is a new dimension of representation specific to the context of multimorbidity which has not previously been addressed. Similarly the *Incoherent Representations* subscale is novel in the measurement of patients' confidence in their understanding of relationships between diabetes and depression.

The DDRMQ also draws on existing measures of single condition medication beliefs with the *Diabetes* and *Depression Medication Worry* subscales including items from the BMQ (Horne et al.1999). The DDRMQ extends existing questionnaires by measuring beliefs about the negative effects and burden of taking multiple medications. Given the observed association between DDRMQ medication subscales and medication adherence, and the increasingly complicated medication regimes for patients with multiple conditions, there may be a need to assess patients' overall sense of medication burden alongside beliefs specific to each condition to fully understand why patients do not always take medication as prescribed.

Unanswered Questions and Future Research

Establishing the reliability and validity of a questionnaire is an on-going process and the current study described only the initial reliability and validity testing of the DDRMQ within one particular sample (Streiner & Norman, 2003). Future investigation of the questionnaire properties, including a confirmatory factor analysis to confirm the underlying factors, is required to further assess the structure and psychometric properties of the DDRMQ.

Following additional validity testing the question as to whether the dimensions measured by the DDRMQ make a significant additional contribution to research and practice requires further investigation. The use of the DDRMQ, a reliable and valid measurement tool, will allow this question to be tested in a structured and replicable manner. The cross-sectional nature of this study resulted in the use of correlational data for construct validity testing and precluded the assessment of predictive validity. Longitudinal studies would allow the relationship between DDRMQ subscales and changes over time in depression severity, blood glucose control and overall health to be evaluated. The DDRMQ could also facilitate the comparison of differences between patients and to inform intervention development through the identification of representation and management categories common to patients with better health outcomes.

Conclusions

When considering the relationship between diabetes and depression it is important to include the perspective of patients themselves, the true experts in the day to day reality of living with this common multimorbidity. The development of the DDRMQ is an initial step in the integration of the patient perspective into the ongoing dialogue on diabetes and depression

and provides a tool to investigate the potential impact of patients' own understandings of diabetes and depression on healthcare interactions and health outcome.

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