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Reliability and Validity of Diabetes Specific Health Beliefs Model Scales in Patients with Diabetes and Serious Mental Illness

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Abstract

AIMS—In this study we evaluate the reliability and validity of existing Health Beliefs Model (HBM) scales developed to assess HBM domains in a population of patients with both diabetes and serious mental illness (SMI). While diabetes medication adherence has frequently been evaluated through the lens of the HBM, it is unclear if developed scales are reliable and valid in patients with SMI.

METHODS—We surveyed 152 veterans with diabetes and SMI. Domains of the HBM assessed included perceived benefits, side effects and barriers to diabetes medication taking, perceived susceptibility to and severity of diabetes, diabetes self-efficacy, diabetes locus of control, and perceived diabetes control.

RESULTS—HBM scales showed good internal reliability within a SMI population, with Cronbach alphas ranging between 0.73 and 0.86 for all scales assessed except one. HBM scales also showed associations with self reported diabetes medication adherences in six of the ten domains.

CONCLUSION—Scales assessing diabetes specific domains of the HBM exhibit both reliability and validity in patients with both diabetes and SMI.

Keywords

Diabetes; Serious Mental Illness; Health Beliefs Model

People with serious mental illness (SMI) are a growing and vulnerable subpopulation of those with diabetes,^{1–3} and, like those without SMI, many have poor diabetes control.⁴ While compared to those without SMI, those with SMI seem to receive comparable care,^{5, 6} comparable or better adherence to diabetes medication,⁷ and comparable or better glucose control, in general, diabetes medication adherence and control remains sub-par for a large proportion of both populations with diabetes.^{4, 6, 7}

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Conflict of Interest

The authors declare that they have no conflict of interest.

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Diabetes medication adherence is clearly linked to diabetes control,^{8, 9} and control is linked to clinical outcomes such as blindness, renal failure, and amputations.^{10–16} Improving diabetes medication adherence among patients has the potential to improve important health outcomes. Although there is a body of literature examining factors associated with diabetes medication adherence in the general population, we know little about whether these factors are associated with medication adherence among patients with SMI. Given this, it is unclear how to best tailor services for this population.

Diabetes medication adherence is frequently evaluated through the lens of the Health Beliefs Model (HBM).^{17–19} However, it is unclear if instruments developed to assess domains of the HBM are reliable and valid in patients with both diabetes and SMI. This is a concern because research suggests that generalized cognitive deficits is a core feature of schizophrenia,^{20, 21} and could be compounded by co-occurring diabetes. Thus, surveys psychometrics assessed in Non-SMI populations may not translate into an SMI population. In this study we qualitatively and quantitatively evaluate existing scales developed to assess diabetes specific HBM domains in veterans with both diabetes and SMI.

MATERIALS AND METHODS

Procedures and Participants

Data was collected between January 2009 and April 2010. In cooperation with both primary and behavioral health care providers at the Philadelphia VA Medical Center and the Bedford VA Medical Center, we identified 152 veterans with diabetes, type was not specified, and SMI (defined here as schizophrenia or bipolar disorder). The first 60 participated as part of a pilot study and the following 92 participated as part of an ongoing study examining whether co-located mental and primary care affect diabetes outcomes in Veterans with SMI. The same instrument was used for all participants. Both the Philadelphia and Bedford IRBs approved all aspects of the studies. This material is based upon work supported in part by the Department of Veterans Affairs, Veterans Health Administration, Office of Research and Development, with the resources and use of the facilities mentioned above.

The first 60 recruited were a convenience sample from the Philadelphia VA Medical Center. A Research Assistant sitting in the behavioral health clinic asked the mental health providers to help identify anyone who had SMI and diabetes (all ICD-9 250 codes). The research assistant would then approach the identified patient and ask if they were interested in completing a 10–20 minute questionnaire. Participants received \$10 for their time. An additional 92 participants were recruited via our internal patient database system. Potential participants were identified by diagnosis codes within the electronic medical records (EMR). All potential participants had a code for SMI and diabetes; had received a diabetes medication from the VA within the last 2 years and were seen within the last year in the behavioral health clinics at either the Philadelphia or Bedford VA Medical Center. In Philadelphia, 260 potential participants met the above criteria. Mental health providers did not approve contact with 60 potential participants for a variety of reasons: 32 because of their fragile mental or physical health, 17 because they did not have SMI (confirmation was done due to concerns regarding high rates of inappropriate SMI diagnosis codes in the VA EMR)²², 2 because they were no longer in the area, 7 because the mental health provider did not remember the patient, and for 2 the mental health provider did not offer a reason. Of the 200, 177 were successfully contacted, and 56 completed the survey by the end of April 2010 (32% participation rate); however, recruitment is ongoing. In Bedford 93 potential participants were identified. Mental health providers did not approve of 15 potential participants: 4 because of their fragile mental or physical health, 7 because they did not have SMI, and for 4 no reason was provided by the provider. Of the 78 patients sent letters, 38 participated in the study, 21 were not interested, and we could not contact the remaining 19

(49% participation rate). As in Philadelphia, recruitment continues. Participants identified via the EMR were given \$20 for completing the survey. All interviews were conducted in private rooms and read to participants with the administrators going over any questions participants had difficulty understanding.

Measures

The survey included several validated scales assessing different domains from the extended HBM^{18, 19} as well as one assessment of medication adherence.²³ HBM domains included perceived benefits, side effects and general barriers to diabetes medication taking, perceived susceptibility to diabetes and diabetic complications and perceived severity of diabetes, diabetes self efficacy, diabetes locus of control, and perceived diabetes control. Scale items are presented in Appendix A.

Medication Adherence—The Morisky Medication Adherence scale is a self-reported measure of medication taking behavior.²³ This scale produces a score from 0 to 4 with 4 being perfect adherence. The scale is well validated and has been associated with glucose control as well as medication adherence as measured by the medication possession ration and electronic devices.^{8, 24, 25} In this study we defined good adherence as having a score of 3 or 4.

Health Belief Model Measures—Perceived benefits were defined as participants' perception of how sticking to their diabetic medication will benefit their overall health.²⁶ This domain consisted of 4 items measured on a 5 point Likert scale ranging from 1 "strongly disagree" to 5 "strongly agree".

Perceived side effects barriers were defined as participants' perception of the discomfort of side effects from diabetes medications as well as their worries about long term effects of their medications.²⁶ These 2 items were measured on a 5 point Likert scale ranging from 1 "strongly disagree" to 5 "strongly agree".

Perceived general barriers were defined as other barriers to taking medications, such as forgetfulness, family problems, difficulty integrating medication taking into daily life and lack of motivation.²⁶ This section consisted of 5 items measured on a 5 point Likert scale ranging from 1 "strongly disagree" to 5 "strongly agree".

Perceived susceptibility was a 2 item domain which looked at the participants' beliefs about what would happen if they did not take medications as directed by their doctor. This included how likely they would be to develop complications, have complications worsen or have shortened life expectancy.²⁶ These items were measured on a 5 point Likert scale ranging from 1 "very unlikely" to 5 "very likely".

Perceived severity was also a 2 item section which looked at the participants' beliefs about the severity of diabetes as a health problem or the severity of complications arising from diabetes as health problems.²⁶ These items were measured on a 5 point Likert scale from 1 "not at all severe" to 5 "extremely severe".

Diabetes self-efficacy was defined as the confidence the participant feels in their ability to manage their diabetes.^{27, 28} This domain consisted of 4 items, which were measured on a 7 point Likert scale ranging from 1 "not at all true" to 7 "very true"

Diabetes locus of control was divided into 3 domains: (1) internal locus of control, which was defined by the participants' beliefs on their ability to control their diabetes, (2) external locus of control defined by participants' belief that others had control over their ability to

manage their diabetes, such as family, friends, or healthcare professionals, and (3) chance locus of control defined by patient's belief that chance or luck determines their diabetes control.²⁹ Each domain had 6 items and these items were measured using a 6 point Likert scale from 1 "disagree" to 6 "agree".

Perceived diabetes control was assessed with a single item asking how well they are managing to control their diabetes. This item was measured on a Likert scale from 1 "not very well" to 5 "very well"

Analysis

For each established scale we calculated a Cronbach alpha to assess internal reliability. We then compared the calculated Cronbach's alpha to the existing published literature assessing these scales in non-SMI populations.^{26, 27, 29,6,7,10} As suggested by Streiner and Norman, we consider a Cronbach's alpha of greater than 0.7 adequate.³⁰ To assess validity, using an independent sample t-test, we compared scale scores between those with good and poor self-reported medication adherence as determined by the diabetes specific Morisky Medication Adherence scale.²³

RESULTS

Table 1 presents the demographics of the population. Their average age was 57.7 (SD 6.9) years old. Participants were 53% (81) African American/Black, 40%, (61) White, and 7% (10) Latin-American, Native-American/American Indian, Bi-racial or unknown. Most were male 81% (123) and were identified by providers as having schizophrenia 70% (107). All participants were able to complete the survey.

Most participants answered easily and quickly questions about: the benefits to taking diabetes medications; diabetes medication side effects; susceptible to diabetes complications; severity of the disease; diabetes self-efficacy; and perceived ability to control their diabetes. Participants needed to take more time to answer the sections about general barriers to medication taking; while the locus of control section was usually answered fairly slowly and research assistants were often asked to repeat statements. However, all participants were able to complete the survey.

For each of the HBM scales, as well as the for medication adherence, we found that the reliability of our results was consistent with the published literature. Eight out of nine HBM scales had a Cronbach's alphas greater than 0.7 with alphas ranging between 0.63 and 0.86 (Table 2). Perceived susceptibility to diabetes complications showed the biggest absolute difference from a non-SMI population (0.73 in SMI population vs. 0.84 in non-SMI population). The internal reliability of the diabetes specific Morisky Medication Adherence Scale was relatively low in the general population and we found a slightly lower value (0.55 in the SMI population vs. 0.61 in a non-SMI population).⁸

In this population 23% of participants reported poor diabetes medication adherence and six out of ten HBM domains assessed were associated with self-reported diabetes medication adherence. Patients who perceived greater benefits to taking their diabetes medications, greater DM self efficacy, and greater perceived control were more likely to report good adherence (Table 3). Those who worried more about side effects, perceived greater barriers to medication taking and those who reported higher belief in chance/luck determining their diabetes control were more likely to report poor adherence. Perceived susceptibility and perceived severity were not statistically associated with self reported adherence.

DISCUSSION

In general, the HBM scales showed acceptable psychometric properties in patients with diabetes and SMI. The HBM scales showed strong internal reliability, with all but one Cronbach alphas over 0.73. In addition, the reliability coefficients were comparable to those in populations with diabetes, but without SMI. While six of the ten scales assessed were associated with self reported diabetes medication adherence.

Only one scale did not show high internal reliability. The perceived side-effects barriers scale had an alpha of 0.63, but this was similar to that seen in the non-SMI population ($\alpha=0.55$),²⁶ indicating the scale has poor overall internal reliability. Interestingly, in this population the scale was associated with self-reported medication adherence. The side effects barriers scale only has two questions. While some of the other scales with good internal reliability had only two questions, perhaps two questions was not adequate to capture the side effects barriers domain. Further development of this scale could potentially strengthen measurement of an important domain which seems to be associated with self-reported medication taking.

Susceptibility to complications and severity of diabetes, internal locus of control and external locus of control were not associated with self reported adherence. This may speak to this population's focus on day-to-day struggles with medication adherence over abstract long term motivators to adherence since these scales have been associated with medication adherence in non-SMI populations.^{18, 19, 31, 32} However, it may also indicate that these scales while valid in non-SMI populations are not valid for this population. On the other hand, self reported adherence may not reflect actual practice and determining the association between these domains and adherence measured by medication possession or actual glucose control may support the scales validity. Unfortunately, in this study we have only one measure of validity. It is also possible that while perceived susceptibility and severity are not associated with medication adherence they could be associated with other important diabetes health behaviors such as following a diabetic diet and exercise. Future studies should assess the relationship between these scales and other behaviors potentially influenced by health beliefs as well as using more objective measures of adherence.

The participants assessed in this study were all veterans recruited from VA behavioral health clinics and were mostly male, thus limiting the generalizability of our findings. We did, however, include an ethnically diverse population with both schizophrenia and bipolar disorder. In addition by only recruiting patients with SMI we had to rely on the published literature for assessments of internal reliability in populations without SMI. Finally the first question in the Morisky Medication Adherence scale was very similar to the first question in the perceived general barriers to medication taking so that may explain the association between the two scales (i.e. they were measuring the same domain); however, each scale had additional questions that were distinctly different thus while related it seems unlikely that they measure the exact same concept.

Given our results, by and large the HBM seems to be a salient model for patients with diabetes and SMI and these scales seem to be a psychometrically sound approach to measuring HBM domains in this population. Among people with serious mental illness (SMI), the prevalence of diabetes is 2–3 times higher than the general population.^{1–3} While care and adherence for this distinct population with diabetes may not be different from those without SMI, this does not mean that efforts to improve outcomes in this population should be exactly the same as efforts to improve outcomes in a non-SMI population. Although preliminary, our results indicate that certain domains of the HBM may be particularly salient to SMI populations and that interventions to improve adherence should potentially target

barriers to medication taking and improving patient self-efficacy. However before interventions can be pursued, these findings need to be replicated in a larger study sample using additional measures of adherence as well as important clinical outcomes such as glucose control.

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Appendix A

Morisky Medication Adherence:

- a. Do you ever forget to take your diabetes medicine?
- b. Are you always careful about taking your diabetes medicine?
- c. When you feel better do you sometimes stop taking your diabetes medicine?

- d.** Sometimes if you feel worse when you take the diabetes medicine, do you stop taking it?

Perceived Benefits:

- a.** Sticking to my diabetes medication will help prevent diseases (complications) related to diabetes.
- b.** Sticking to my diabetes medication will help me control my diabetes.
- c.** Sticking to my diabetes medication will help me feel better.
- d.** Sticking to my diabetes medication will help me live longer.

Perceived Side Effects:

- a.** Diabetes medications cause annoying side effects.
- b.** I sometimes worry about the long term effects of my diabetes medication.

Perceived General Barriers:

- a.** I have difficulty remembering when to take my diabetes medication.
- b.** Family problems make it difficult for me to take my diabetes medication regularly.
- c.** I would have to change too many habits to take my diabetes medication regularly.
- d.** Taking my diabetes medication interferes with my normal daily activities.
- e.** I don't feel motivated to take my diabetes medication regularly.

Perceived Susceptibility:

- a.** How likely will you be to develop the complications of diabetes or have complications worsen?
- b.** How likely are you to have a shortened life expectancy?

Perceived Severity:

- a.** To what extent do you consider diabetes to be a severe health problem?
- b.** To what extent do you consider complications arising from diabetes to be severe health problems?

Diabetes Self Efficacy:

- a.** I feel confident in my ability to manage my diabetes.
- b.** I feel capable of handling my diabetes now.
- c.** I am able to do my own routine diabetes care now.
- d.** I am able to meet the challenges of controlling my diabetes.

Perceived Locus of Control Internal:

- a.** If I take care of myself, I can minimize diabetic complications.
- b.** The main thing which affects whether I will develop diabetic complications is what I do for myself.
- c.** If I avoid diabetic complications, it's because of my efforts.
- d.** If my diabetes goes out of control, it is my own behavior which determines how soon I get back in control again.

- e. If I take the right actions, I can keep my diabetes in control.
- f. The main thing which affects my diabetes control is what I do for myself.

Perceived Locus of Control External:

- a. Having regular contact with other people who have diabetes is the best way for me to avoid developing diabetic complications.
- b. My family has a lot to do with whether or not I will develop diabetic complications.
- c. If I am able to avoid diabetic complications it's because other people (for example doctor, nurses, family, friends) have been taking good care of me.
- d. When I am able to keep my diabetes in control it's because other people (for example doctor, nurses, family, friends) have been taking good care of me.
- e. My family has a lot to do with my diabetes being in control or out of control.
- f. Having regular contact with my doctor is the best way for me to keep my diabetes in control.

Perceived Locus of Control Chance:

- a. Avoiding diabetic complications is largely a matter of good fortune.
- b. No matter what I do, I'll probably develop diabetic complications.
- c. If it's meant to be my diabetes will stay in control.
- d. When my diabetes goes out of control, it's usually by accident.
- e. No matter what I do, my diabetes is likely to go out of control.
- f. Most things that affect my diabetes happen by accident.

Perceived Diabetes Control:

- a. How well do you think you are managing to control your diabetes?

Table 1

Patient Demographics

Age, mean (SD)	N=152
	57.7 (6.9)
Race, n (%)	
AA/black	81 (53.3%)
White	61 (40.1%)
Other	10 (6.9%)
Male, n (%)	123 (80.9%)
Female, n (%)	29 (19.0%)
Primary SMI Diagnosis, n (%)	
Schizophrenia	107 (70.4%)
Bipolar Disorder	45 (29.5%)

Table 2

Internal Reliability for Diabetes Specific Health Belief Model Scales

	Study Sample Cronbach α	Non-SMI population Cronbach α *
Perceived Benefits to Diabetes Medication Taking	0.84	0.90 ²⁶
Perceived Side Effects Barriers	0.63	0.55 ²⁶
Perceived Barriers to Diabetes Medication Taking	0.86	0.83 ²⁶
Perceived Susceptibility to Diabetes and Complications	0.73	0.84 ²⁶
Perceived Severity of Diabetes	0.79	0.86 ²⁶
Diabetes Self-efficacy	0.84	0.88 ²⁷
Diabetes Locus of Control		
Internal	0.81	0.75 ²⁹
External	0.76	0.72 ²⁹
Chance	0.73	0.77 ²⁹

* from cited literature

Table 3

Health Belief Model Scale Scores and Diabetes Medication Adherence

	Overall Mean (SD)	Good Adherence Mean (SD)	Poor Adherence Mean (SD)	p-Value
Perceived Benefits to Diabetes Medication Taking	17. (2.5)	17.5 (2.4)	16.1 (2.7)	0.004
Perceived Side Effects Barriers	5.1 (2.1)	4.9 (2.0)	5.9 (2.3)	0.013
Perceived General Barriers to Medication Taking	10.1 (4.1)	9.1 (3.1)	13.6 (5.1)	<0.001
Perceived Susceptibility to Diabetes Complications	8.4 (1.8)	8.4 (1.9)	8.3 (1.3)	0.622
Perceived Severity of Diabetes	8.4 (1.8)	8.4 (1.9)	8.3 (1.7)	0.831
Diabetes Self-efficacy	23.3 (4.7)	23.8 (4.3)	21.3 (5.2)	0.004
Diabetes Internal Locus of Control	30.9 (4.2)	31.0 (4.2)	30.8 (4.2)	0.777
Diabetes External Locus of Control	25.2 (6.1)	25.1 (6.0)	25.7 (6.5)	0.614
Diabetes Chance Locus of Control	18.2 (6.2)	17.7 (6.0)	20.0 (6.5)	0.048
Perceived Diabetes Control	4.1 (1.0)	4.2 (1.0)	3.8 (1.0)	0.042