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The association of minor and major depression with health problem-solving and diabetes self-care activities in a clinic-based population of adults with type 2 diabetes mellitus

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Abstract

Aims: We examined whether problem-solving and diabetes self-management behaviors differ by depression diagnosis - major depressive disorder (MDD) and minor depressive disorder (MinDD) - in adults with Type 2 diabetes (T2DM).

Methods: We screened a clinical sample of 702 adults with T2DM for depression, identified 52 positive and a sample of 51 negative individuals, and performed a structured diagnostic psychiatric interview. MDD (n = 24), MinDD (n = 17), and no depression (n = 62) were diagnosed using Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV) Text Revised criteria. Health Problem-Solving Scale (HPSS) and Summary of Diabetes Self-Care Activities (SDSCA) questionnaires determined problem-solving and T2DM self-management skills, respectively. We compared HPSS and SDSCA scores by depression diagnosis, adjusting for age, sex, race, and diabetes duration, using linear regression.

Results: Total HPSS scores for MDD ($\beta = -4.38$; $p < 0.001$) and MinDD ($\beta = -2.77$; $p < 0.01$) were lower than no depression. Total SDSCA score for MDD ($\beta = -10.1$; $p < 0.01$) was lower than for no depression, and was partially explained by total HPSS.

Conclusion: MinDD and MDD individuals with T2DM have impaired problem-solving ability. MDD individuals had impaired diabetes self-management, partially explained by impaired problem-solving. Future studies should assess problem-solving therapy to treat T2DM and MinDD and integrated problem-solving with diabetes self-management for those with T2DM and MDD.

Keywords

Type 2 diabetes mellitus; Depression; Major depressive disorder; Minor depressive disorder; Problem-solving; Diabetes self-care activities

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1. Introduction

The prevalence of depression in adults with type 2 diabetes (T2DM) is almost twice as high as in those without diabetes.[2] More specifically, the prevalence of major depressive disorder (MDD), assessed by structured or semi-structured interviews (e.g., the Diagnostic Interview Schedule) and diagnosed according to the *Diagnostic and Statistical Manual of Mental Disorders*, is approximately 11.4% in adults with T2DM.[3] The prevalence of self-reported "elevated depressive symptoms" is much higher, estimated at 31%, suggesting that individuals with T2DM may have other depressive disorders, such as minor depression. We recently estimated the prevalence of minor depression (MinDD) to be 13.8% in a clinic-based population of individuals with T2DM using a structured psychiatric interview, suggesting that MinDD may have a similar prevalence as MDD in this population.[20] Comorbidity between depressive disorders and T2DM has significant implications for patient outcomes as patients with T2DM and depression have an increased risk of mortality,[25] poorer health,[28] and increased risk of complications[7] when compared to T2DM patients without depressive disorders.

Several studies suggest that the impact of depression on T2DM control may be mediated by behavioral mechanisms. Depression is associated with maladaptive health behaviors (smoking, physical inactivity, increased caloric intake, decreased medication adherence)[9,12,27] impaired problem-solving ability,[19] and impaired self-efficacy,[10,33] all considered to be related to an individual's glycemic control.[21] Some studies have assessed whether other depressive disorders impact self-management behaviors or quality-of-care indicators (i.e. annual physician visits, HbA1c tests, foot evaluations, eye examinations, and flu and pneumonia shots).[10] However, most studies have not used a "gold standard" psychiatric interview, following the Diagnostic and Statistical Manual (DSM) of Mental Disorders criteria, to clinically differentiate between MinDD and MDD. This limits our ability to understand the extent to which different depressive syndromes impact metabolic control and behavioral management of T2DM.

In this study we examined whether problem-solving and diabetes self-care behaviors differed by depressive disorder diagnosis. We hypothesized that individuals with T2DM and MinDD would have poorer health behaviors and problem-solving skills compared to individuals with no depressive disorder. We further hypothesized that individuals with T2DM and MinDD would have health behaviors and problem-solving skills intermediate between those with MDD and no depressive disorder.

2. Methods

2.1. Study population and depression screening

Participants with physician-confirmed T2DM who were 18 years of age or older were recruited from the Diabetes Center clinics at Johns Hopkins Hospital, where 5 physicians, 3 nurse practitioners, and a nutritionist see patients daily. As part of routine practice, patients were screened for depressive symptoms using the Patient Health Questionnaire (PHQ)-2 questionnaire. The PHQ-2 asks the following two questions, which were scored between "0"

(not at all) and "3" (nearly every day): "Over the past two weeks how often have you been bothered by any of the following problems? "

1. Little interest or pleasure in doing things.
2. Feeling down, depressed, or hopeless.

As previously described,[20] individuals were considered to screen positive with a score of ≥3 (summing answers from both questions), which reflects a 75% probability of having a depressive disorder.[26] We also asked participants if they had been told that they have MDD or were being treated with antidepressants or psychotherapy, in order to capture individuals with MDD not detected by the PHQ-2 because their symptoms were adequately controlled. We included these individuals along with those who screened positive on the PHQ-2 to avoid misclassification and underestimation of the prevalence of MDD. Otherwise, individuals scoring <3 on the PHQ-2 were considered not to have clinically significant depressive symptoms.[20]

2.2. Participant recruitment for psychiatric diagnostic interview

Between February 1,2011, and June 30,2013, all patients with T2DM seen in the clinic underwent PHQ-2 screening as routine clinical practice and had psychiatric history obtained, providing the sample prevalence of those screening positive and negative for depression for our T2DM clinic population. Individuals who screened positive for depressive symptoms on the PHQ-2 (score ≥ 3), who carried a diagnosis of MDD, or who were taking antidepressant medications (collectively referred to as "screen positive" henceforth) were asked about their willingness to participate in our study. Patients with positive screening for depressive symptoms who provided written informed consent were enrolled, completed questionnaires, and underwent a structured diagnostic interview based on the *DSM-IV* to characterize their depressive disorder and to investigate past, as well as current, depressive symptomology. At the time of study enrollment in 2011, we excluded individuals taking antipsychotic medications, as these individuals were likely to have a major mental illness such as bipolar disorder. We acknowledge, however, that current practice incorporates antipsychotic use as augmentation strategies for MDD.[22] We also excluded individuals using glucocorticoids since glucocorticoids can induce mood disorders including depression. Our goal was to identify 100 patients who screened positive for depressive symptoms or who had other evidence of depression. In a prior study, 13.6% of patients with diabetes and congestive heart failure were identified as depressed using the PHQ-2 screening questionnaire,[34] so we anticipated a priori needing to screen approximately 750 individuals to identify 100 patients who screened positive and were eligible to be further evaluated with a structured diagnostic interview. This subsample of patients undergoing the structured diagnostic interview provided depression prevalence estimates within patients who screened positive for depressive symptoms.[20]

To address the potential for screening bias on the PHQ-2, namely false negatives, we invited a convenience sample of 51 consecutive individuals who screened negative (defined as PHQ-2 score <3 without self-reported MDD) and agreed to be contacted and consented for the structured diagnostic interview. This subsample undergoing SCID provided depression prevalence estimates for patients who were screened negative for depressive symptoms.[20]

Patients willing to participate provided written informed consent. This study was approved by a Johns Hopkins University School of Medicine Institutional Review Board.

2.3. Structured Clinical Interview for Diagnostic and Statistical Manual (DSM-IV) Axis I Disorders, Non-Patient Edition (SCID-I/NP)

Participants who screened positive and a sample of those who screened negative and agreed to be contacted underwent a diagnostic interview using the SCID-I/NP Research Version within 30–60 days of their clinic visit. The SCID is deemed a gold-standard, structured interview for the diagnosis of mental disorders.[13,14] The SCID-I/NP is designed for use in studies in which the participants are not identified as psychiatric patients.[13] The SCID-I/NP was administered by a physician research coordinator (M.N.) trained and supervised by a study psychiatrist with expertise in depressive disorders (J.P.).[20] He administered the modules outlined in the appendix, which enabled us to specifically characterize depressive disorders and distinguish them from other Axis I disorders. Module J included diagnostic criteria for MinDD. The SCID-I/NP was scored according to the User's Guide.[14] The lifetime presence of a disorder was first determined followed by assessment of whether the criteria for the disorder were *currently* met.[13]

2.4. Health Problem-Solving Scale (HPSS) questionnaire and scoring

To determine participant problem-solving and decision making skills in T2DM self-management, the Health Problem-Solving Scale (HPSS) questionnaire was self-administered following written informed consent. The HPSS is a 50-item instrument, based on a model of problem-solving in chronic disease self-management[15] and developed from previous studies ([15]; Hill-Briggs, Cooper, Loman, Brancati & Cooper, 2003).[35] It has seven subscales to represent the different aspects of health-related problem-solving: (1) rational problem-solving (RPS, e.g., "I always take time to consider how the things I choose to do can help or hurt my health condition(s)"); (2) impulsive/careless problem-solving (IPS, e.g., "Sometimes I decide that I'm going to stop taking care of my health condition(s) and do the things I want to do"); (3) avoidant problem-solving (APS, e.g., "I put off trying to deal with problems with my health condition(s) as long as I can"); (4) positive transfer of past experience/learning (PTR, e.g., "I know exactly what types of problems I could have with my health condition(s) and my body each day"); (5) negative transfer of past experience/learning (NTR, e.g., "I can't find ways to stop problems with my health condition(s) from getting worse"); (6) positive motivation/orientation (PMO, e.g., "I am able to prevent my health condition(s) from interfering with my life"); and (7) negative motivation/orientation (NMO, e.g., "I try to conquer my health condition(s), but problems with my health are conquering me").

Participants used a 5-point Likert scale to record their answers, which were scored as follows: "not at all true of me" (0 point), "a little true of me" (1 point), "moderately true of me" (2 points), "very true of me" (3 points), and "extremely true of me" (4 points). The subscale scores were then calculated by summing up the scores for each item in the corresponding subscales. To calculate the total HPSS score, the negative subscales (i.e., IPS, APS, NTR, NMO) were first reverse scored, and then all the subscale averages were summed up using the following formula: (RPS/9) + [(32 - IPS)/8] + [(28 - APS)/7] +

(PTR/5) + [(44 - NTR)/11] + (PMO/5) + [(20 - NMO)/5].[23] Higher subscale scores indicate better problem-solving characteristics. Higher total HPSS scores indicate that the participant is more effective at overall health-related problem-solving.

2.5. Summary of Diabetes Self-Care Activities (SDSCA) questionnaire and scoring

The SDSCA is a 12-item self-report questionnaire developed to assess the level of self-care in five aspects of the diabetes management: diet, exercise, blood sugar testing, foot care, and medication taking.[32] This questionnaire was self-administered following written informed consent. On the questionnaire, the participants were asked to write how many of the last seven days they participated in certain activities pertaining to each of the five aspects of self-care (e.g., “How many of the last seven days have you followed a healthful eating plan?”). The subscale scores were calculated by summing up the items in each respective subscale. The total SDSCA score was then calculated by summing up all the subscale scores. Higher subscale score indicates that the individual shows more frequent self-care behavior in that category. Higher total SDSCA score indicates that the individual has overall greater T2DM self-care.

2.6. Statistical analyses

We used one-way analysis of variance (ANOVA) to compare the HPSS and Self Care scores - both total scores and sub-category scores - of participants by depression diagnosis status (i.e. no depression, MinDD [current and/or past], and MDD [current and/or past]). We compared the mean HPSS total and subscale scores and SDSCA total and subscale scores in those with MDD (current and/or past) and MinDD (current and/or past) compared to those without a depressive disorder. We used multiple linear regression to estimate mean differences in HPSS and SDSCA scores in those with MDD and MinDD compared to those without a depressive disorder, later adjusting for age, sex, and duration of T2DM, all confounders that have been associated with depression[20] and health behaviors. We also used multiple linear regression to determine the mean difference in total SDSCA scores for each one-point change in total HPSS scores in the whole group as well as stratified by depression category (MDD, MinDD, and no depressive disorder). All analyses were conducted using the statistical software package Stata/SE version 12.0 (StataCorp, College Station, TX, USA). A two-sided alpha of 0.05 was used to determine statistical significance.

3. Results

3.1. Screening

From February 1, 2011 to June 30, 2013, PHQ-2 screening was completed by 702 patients with T2DM. Of these patients, 161 (23%) screened positive and 541 (77%) screened negative for depressive symptoms. Out of those that screened positive, 112 (70%) agreed to be contacted for SCID-I/NP interview, 62 (55%) of the 112 underwent informed consent, and ultimately 52 (46%) went through the SCID-I/NP interview. Out of those that screened negative, 237 (46%) agreed to be contacted for SCID-I/NP interview, and a convenience sample of 51 patients were selected from that pool to undergo the SCID-I/NP interview as previously described.[20]

3.2. Health Problem-Solving Scale (HPSS) scores and depression status

Table 1 shows the mean scores and standard deviations on the total HPSS and its subscales. Compared to those without a depressive disorder, individuals with MinDD and MDD had significantly lower total HPSS scores (Table 1). The total HPSS scores for MinDD and MDD were 2.64 points ($p = 0.010$) and 4.24 points lower ($p = 0.000$), respectively, than for those without a depressive disorder. There were also notable differences in subscale scores by depressive disorder diagnosis. Those with MinDD and MDD had lower Rational Problem-solving scores and higher Negative Transfer scores compared to those without a depressive disorder (Table 1). In those with MinDD Positive Motivation/Orientation scores were lower by 2.00 points ($p = 0.032$) compared to those without depressive disorders; this score was also lower in those with MDD although not significantly so. Individuals with MDD had higher scores for Impulsive/Careless and Avoidant Problem-solving and Negative Motivation/Orientation compared to the non-depressed (Table 1). These subscale scores were not associated with MinDD (Table 1). There was no difference in Positive Transfer (of Past Experience/Learning) scores between those with MDD and MinDD and no depressive disorder. All statistically significant associations remained so following adjustment for age, sex, and diabetes duration (Table 2). Some responses to the HPSS questionnaire were missing at random, which did not differ by depression status. We performed a secondary analysis, excluding individuals with missing questionnaire data on a portion of the questionnaire and our findings were unchanged (data not shown).

3.3. Summary of Diabetes Self-Care Activities (SDSCA) scores and depression status

Table 1 displays the mean scores and standard deviations on the total SDSCA and its subscale. Neither the total SDSCA score nor the subscale scores were associated with MinDD (Table 1). However, individuals with MDD had lower total SDSCA and diet and blood sugar subscale scores compared to those without a depressive disorder (Table 3). These associations remained following adjustment for age, sex and diabetes duration. The exercise, foot care, and medication subscales were not associated with depression diagnosis in unadjusted or adjusted analyses.

3.4. Association of health problem-solving and self-care behaviors

In the full study sample, every one-point increase in the total HPSS score (indicating more effective problem solving), resulted in a total SDSCA score that was 0.074 points higher ($p = 0.006$). To examine whether health problem solving accounted in part for the association between depression status and self-care behaviors, the ANOVA models were further adjusted for HPSS score in a secondary analysis. After adjusting for total HPSS, the previously robust association between total SDSCA score and MDD was reduced to borderline significance ($p = 0.06$). The lack of association between SDSCA and MinDD did not change with adjustment for HPSS.

4. Discussion

In this study, we aimed to understand the association between minor and major depressive disorders and health-related problem-solving skills and diabetes self-care behaviors in a clinic-based sample of adults with T2DM. As hypothesized, we found that individuals with

both MinDD and MDD performed significantly worse on total health-related problem-solving compared to individuals with no depressive disorder. When compared to individuals with MDD and individuals with no depressive disorder, those with MinDD had intermediate HPSS scores between the other groups. We also found that individuals with both MinDD and MDD, compared to those without depression, scored lower on the rational problem-solving and higher on the negative transfer subscales while only those with MDD scored higher on the impulsive/careless, avoidant, and negative motivation/orientation subscales. For diabetes self-care activities, individuals with MDD showed significantly worse mean scores on the total as well as most subscales of the SDSCA when compared with non-depressed individuals. While not statistically significant, individuals with MinDD showed a trend toward poorer performance on diabetes self-care activities that was intermediate between those with MDD and no depression.

In examining the HPSS subscale scores, the positive subscales (i.e., Positive Transfer, Positive Motivation/Orientation) were not consistently associated with depression diagnosis and were generally not significant. In contrast, individuals with MinDD and MDD scored higher on the Negative Transfer subscale and lower on the Rational subscale and individuals with MDD exhibited more Negative Motivation/Orientation, Avoidant, and Impulsive/Careless problem-solving - those with MinDD scored intermediate between those with MDD and no depression on the latter 3 subscales. These findings are consistent with a tendency of persons experiencing depressive symptoms to focus on and endorse more negatively rather than positively-oriented thoughts and approaches.

Overall, our findings support and extend prior research suggesting that individuals with T2DM and comorbid depression have worse problem-solving behaviors than their non-depressed counterparts (Glasgow et al., 2007).[19] In one cross-sectional study using a large, multiracial sample of patients with T2DM and varying characteristics (i.e., number of comorbid conditions, number of diabetes complications, education level, sex, race/ethnicity, BMI), the Diabetes Problem-Solving Interview (DPSI) was used to assess the association of problem-solving skills related to diabetes self-management (i.e., healthful eating, physical activity) (Glasgow et al., 2006). Depressive affect was measured on the Center for Epidemiologic Studies-Depression Scale (CES-D) and disease-related distress was measured by the Diabetes Distress Scale. In this sample, scoring higher on the CES-D and the Diabetes Distress Scale-indicating higher instances of depressive affect and diabetes-related distress - was associated with scoring more poorly on the DPSI (Glasgow et al., 2006). Also, the study found that each subcategory of the DPSI (i.e., dietary problem-solving, exercise problem-solving) was related to its respective self-management behaviors (e.g., dietary problem-solving score was associated with dietary self-care activities score and not with exercise self-care score) even after controlling for depressive affect (Glasgow et al., 2006). Our study extends these observations, as not only was health problem solving associated with self-care behaviors in the total sample, but problem solving explained, in part, the association between MDD and self-care behaviors. While not the primary focus of our initial analyses, this finding supports additional studies to explore the potential role for problem solving as an intervention target not only for MDD, but for diabetes self-care behavior as well.

Prior research has also found that MDD in individuals with T2DM is associated with worse self-care practices. In a study using data from the 2006 Behavioral Risk Factor Surveillance System (BRFSS) national survey, which included a depression module based on PHQ-8 and a self-reported diagnosis of diabetes, individuals with T2DM and MDD were shown to participate in fewer general preventive self-care behaviors (i.e., not drinking excessively and receiving timely screenings for breast, cervical, prostate, and colorectal cancers) than their non-depressed counterparts.[11] While our study looked more specifically at diabetes-related self-care activities in individuals with T2DM and MDD or MinDD, our results support the prior findings that comorbid MDD in T2DM leads to worse self-care. Also, in a cross-sectional study looking at the SDSCA scores of individuals with T2DM and differing levels of depression, the severity of depression (i.e., no depressive symptoms, moderate depression, and severe depression as categorized by PHQ-9 scores) was inversely correlated with the total and subscale SDSCA scores, indicating an overall lower quality of self-care activities in depressed individuals.[29] While our study showed that there was no significant correlation between MinDD and SDSCA scores, unlike the significantly lower SDSCA scores for the MDD group, individuals with T2DM and MinDD still showed an overall pattern of scoring intermediately between individuals with T2DM and MDD and non-depressed individuals with T2DM. These findings suggest that treatments for individuals with T2DM and MinDD or MDD should include ways to motivate these individuals to participate more in diabetes self-care activities.

Past studies have shown the feasibility of applying problem-solving intervention for patients with T2DM and comorbid depression.[1,31] However, the studies reveal that problem-solving interventions for depression alone do not directly benefit diabetes control (i.e. HbA1c) in these patients, but the interventions prove to be useful in treating their comorbid depression. However, randomized trials demonstrate that problem-solving-based diabetes self-management interventions can be effective in improving diabetes self-care behaviors as well as HbA1c, blood pressure, and cholesterol in T2DM patients in poor disease control, who are not pre-selected for comorbid depression.[16,17,24]

Our findings suggest that interventions targeting *both* self-care behaviors and depression may be needed targeting individuals with T2DM who have *either* MinDD or MDD. It is important to note that pharmacotherapy has not been shown to be effective in those with MinDD and subthreshold depression whereas psychotherapeutic approaches have been effective.[4,6,18,30] Specifically, psychoeducation and low-intensity psychotherapies, such as problem-solving, may reduce progression of subthreshold depression to MDD.[6,30] While diabetes self-management activities were not as impaired in those with MinDD compared to those with MDD, individuals with MinDD had significant impairment of health problem-solving ability similar to those with MDD. This implies that individuals with T2DM and MinDD may particularly benefit from problem-solving based interventions for treatment of depressive symptoms. Given that individuals with MDD demonstrate significant impairment in both health problem-solving ability and diabetes self-care behaviors, our findings suggest that they would benefit from an integrated problem-solving approach addressing both depression and diabetes self-management.

Our study has several strengths. First, we used a psychiatric diagnostic interview, SCID-I/NP, to establish depression diagnoses in individuals with T2DM, distinguishing MinDD and MDD, and examine their associations with health problem-solving and diabetes self-care activities. Prior studies relied on depression questionnaires. Second, this study includes a measure of health-related problem-solving to examine relationships among depression status and self-care in diabetes. The use of HPSS allowed us to assess core components of problem-solving that have previously been established as important to mental and physical health status.[8,23,24]

Our study also has limitations that should be considered in interpreting our findings. First, the cross-sectional nature prevents us from determining causality as we cannot determine the temporal sequence of self-care activities and depression -that is, poor self-care could lead to increased depression and/or increased depression could lead to poor self-care. Second, study results can only be generalized to clinic- and not community-based populations with T2DM and needs to be replicated in other groups. Third, we conducted our psychiatric evaluation based on MDD and MinDD criteria using the DSM-IV-TR, the most current version at the time of our study (DSM-V was released after the study was over). Fourth, while the SDSCA is one of the most widely used self-reporting tools to assess diabetes self-management, there is currently no “gold standard” measure of diabetes self-care.[5] Also, considering that the SDSCA subscales only contain a small number of items, subscale means are less robust at assessing the extent of diabetes self-management in each of the dimensions measured by the subscales.

In conclusion, individuals with T2DM and both MinDD and MDD have impaired health problem-solving ability and those with MinDD have total diabetes self-management activity scores intermediate between those with MDD and no depression. Psychotherapeutic problem-solving approaches addressing MinDD in patients with T2DM may improve depression outcomes and problem-solving skills and prevent progression from MinDD to MDD, the latter being associated with both impaired problem-solving and diabetes self-care. Finally, an integrated problem-solving approach for both depression and diabetes self-management may be particularly beneficial in those with T2DM and MDD. Future studies are needed to examine the impact of such interventions.

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Table 1

Baseline demographic and health problem-solving and diabetes self-care activity scores by depression diagnosis status.

Characteristic Score mean (SD)	No depressive disorder (reference) n = 62	MinDD (current and/or past) n = 17	MDD (current and/or past) n = 24
Age in years, mean ± SD	61.5 ± 12.1	55.4 ± 11.4	57.1 ± 10.2
Sex, Female (%)	50.0	64.7	79.2 *
Diabetes duration (years), median (1st, 3rd Quartile)	13.5 (5, 20)	10 (6.5, 14)	8 (4, 13)
Total Health Problem-Solving Scale (HPSS), mean ± SD	20.9 (3.74)	18.3 (3.86) **	16.7 (3.35) ***
Rational problem-solving	22.1 (6.90)	17.8 (5.82) *	18.4 (6.68) *
Impulsive/careless problem-solving	6.1 (6.05)	8.8 (5.14)	12.6 (7.49) ***
Avoidant problem solving	3.9 (4.91)	6.0 (6.25)	9.5 (5.41) ***
Positive transfer	12.6 (.19)	10.9 (3.54)	12.3 (4.16)
Negative transfer	10.3 (7.33)	15.1 (8.74) *	19.7 (7.94) ***
Positive motivation/orientation	14.1 (3.59)	12.1 (2.64) *	12.6 (3.09)
Negative motivation/orientation	3.1 (3.48)	4.9 (4.59)	8.1 (4.79) ***
Total Summary of Diabetes Self-Care Activities (SDSCA), mean ± SD	53.1 (13.48)	47.5 (13.44)	41.5 (16.50) ***
Diet	16.8 (6.29)	14.8 (6.34)	11.6 (6.40) ***
Exercise	5.4 (4.63)	3.5 (2.60)	4.6 (5.68)
Blood sugar	11.2 (4.70)	10.3 (5.54)	7.9 (5.94) **
Foot care	8.6 (5.00)	8.6 (4.68)	6.7 (4.63)
Medication	11.1 (4.41)	10.3 (5.02)	10.7 (5.09)

* $p \leq 0.05$.

** $p \leq 0.01$.

*** $p \leq 0.001$.

Table 2

Analysis of variance (ANOVA) between HPSS scores and depression status.

Scale / subscale	Depression group	Unadjusted	Adj. for age, sex	Adj. for age, sex, DM duration
Total Health Problemsolving Scale (HPSS)	No disorder (reference)	0	0	0
	MinDD	−2.64**	−2.88**	−2.77**
	MDD	−4.24***	−4.63***	−4.38***
Rational problem solving	No disorder (reference)	0	0	0
	MinDD	−4.28*	−4.36*	−4.28*
	MDD	−3.67*	−3.83*	−3.65*
Impulsive / careless problem-solving	No disorder (reference)	0	0	0
	MinDD	2.74	3.48*	3.16
	MDD	6.50***	7.40***	6.73***
Avoidant problem solving	No disorder (reference)	0	0	0
	MinDD	2.06	2.31	2.09
	MDD	5.52***	5.99***	5.53***
Positive transfer	No disorder (reference)	0	0	0
	MinDD	−1.64	−1.62	−1.57
	MDD	−0.331	−0.301	−0.188
Negative transfer	No disorder (reference)	0	0	0
	MinDD	4.80*	5.50**	5.38**
	MDD	9.41***	10.51***	10.25***
Positive motivation/ orientation	No disorder (reference)	0	0	0
	MinDD	−2.00*	−1.98*	−1.90*
	MDD	−1.49	−1.50	−1.34
Negative motivation/ orientation	No disorder (reference)	0	0	0
	MinDD	1.83	2.08	2.08
	MDD	5.08***	5.52***	5.52***

* $p \leq 0.05$.

** $p \leq 0.01$.

*** $p \leq 0.001$.

Table 3

Analysis of variance (ANOVA) between SDSCA scores and depression status.

Scale / subscale	Depression group	Unadjusted	Adj. for age, sex	Adj. for age, sex, DM duration
Total Summary of Diabetes Self-Care Activities (SDSCA)	No disorder (reference)	0	0	0
	MinDD	−5.66	−5.86	−5.21
	MDD	−11.63***	−11.48**	−10.08**
Diet	No disorder (reference)	0	0	0
	MinDD	−2.07	−2.16	−2.15
	MDD	−5.21***	−5.35***	−5.32**
Exercise	No disorder (reference)	0	0	0
	MinDD	−1.87	−2.08	−1.98
	MDD	−0.820	−0.900	−0.689
Blood sugar	No disorder (reference)	0	0	0
	MinDD	−0.867	−0.571	−0.433
	MDD	−3.24**	−2.69*	−2.39
Foot care	No disorder (reference)	0	0	0
	MinDD	0.00759	−0.183	0.192
	MDD	−1.91	−2.31	−1.51
Medication	No disorder (reference)	0	0	0
	MinDD	−0.851	−0.859	−0.833
	MDD	−0.437	−0.221	−0.166

* $p \leq 0.05$.

** $p \leq 0.01$.

*** $p \leq 0.001$.