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Symptoms of Depression Prospectively Predict Poorer Self-Care in Patients with Type 2 Diabetes

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Abstract

AIMS—To prospectively examine the association of depression symptoms with subsequent self-care and medication adherence in patients with type 2 diabetes mellitus.

METHODS—208 primary care patients with type 2 diabetes completed the Harvard Department of Psychiatry/National Depression Screening Day Scale (HANDS), and the Summary of Diabetes Self-Care Activities (SDSCA) at baseline. They also self-reported medication adherence at baseline and at a follow-up, a mean of 9 months later.

RESULTS—Baseline HANDS scores ranged from 0 to 27, with a mean score of 5.15± 4.99. In separate linear regression models that adjusted for baseline self-care, patients with higher levels of depressive symptoms at baseline reported significantly lower adherence to general diet recommendations and specific recommendations for consumption of fruits and vegetables and spacing of carbohydrates; less exercise; and poorer foot care at follow-up (ßs ranging from -0.12 to -0.23; ps <0 .05). Similarly, each one-point increase in baseline HANDS score was associated with a 1.08-fold increase in the odds of nonadherence to prescribed medication at follow-up (95% CI = 1.001 - 1.158, p = 0.047). Increases in depression scores over time also predicted poorer adherence to aspects of diet and exercise.

CONCLUSIONS—Depressive symptoms predict subsequent nonadherence to important aspects of self-care in patients with type 2 diabetes, even after controlling for baseline self-care. Though the relationship between symptoms of depression and poorer diabetes self care is consistent, it is not large and interventions may need to simultaneously address depression and self-care skills in order to maximize effects on diabetes outcomes.

Keywords

Diabetes; Depression; Adherence; Self-care; Compliance

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INTRODUCTION

Individuals with diabetes frequently experience depression symptoms. The risk of major depressive disorder, for example, is nearly twice as high in patients with diabetes compared to those without diabetes, with meta-analyses reporting point prevalence estimates from 11.0-17.6%, compared to estimates of only 3-4% in the general population [1,2,3]. Moreover, severe symptoms of depression are present in 26-31% of patients with diabetes [1,4]. Compared to type 2 diabetes patients without comorbid depression, major depression is associated with a 2.30-fold increase in mortality and minor or "subclinical" depression is associated with a 1.67-fold increase [5]. Depression also increases the risk of hyperglycemia [6] and diabetes complications [7].

Depression may be associated with poorer diabetes outcomes through decreases in self-care and adherence. Meta-analysis has shown that depression is a risk factor for nonadherence to medical treatment in other chronic illnesses, with depressed patients carrying 3-times greater risk of nonadherence than non-depressed patients [8]. In diabetes, depression has been consistently associated with poorer adherence to diet [9,10,11,12] exercise [10,11,12], and prescribed medications [9,11,12,13]. A probable diagnosis of major depression has also been associated with poorer adherence to glucose self-monitoring [12]. While available literature suggests that depression could impact diabetes outcomes through reductions in self-care and medication adherence, the directionality and possible causal nature of the relationship between depression and self-care/adherence is unclear due to reliance on cross-sectional analyses in most studies.

Although studies have examined the prospective relationship between depression and self-care [14], we are unaware of any study that controlled for baseline levels of self-care when examining the relationship between depression and self-care over time. In this report, we examined the prospective relationship between baseline depression symptoms and a complete set of diabetes self-care behaviours measured 9 months later. We expected that depression symptoms would predict poorer diabetes self-care behaviours over time, even after adjusting for each patient's baseline level of self-care. This would provide preliminary evidence for the directionality and causal nature of the relationship between depression and self-management in type 2 diabetes.

PATIENTS AND METHODS

Study Sample

We surveyed patients with type 2 diabetes who were followed in one of two outpatient primary care medical clinics between December 2001 and July 2003. Full details regarding recruitment procedures and participant characteristics have been described previously [12,15,16,17]. Briefly, clinical sites were a community health centre serving a predominantly working class community in Revere, Massachusetts, and a hospital-based primary care internal medicine practice in Boston. Eligible patients had established type 2 diabetes, were alive at study completion, and received continuous care at their designated clinical site, with at least one visit during the study period. The Massachusetts General Hospital Institutional Review Board approved the study.

Survey administration

Potential participants were mailed a letter co-signed by their primary care provider and the principal investigator (JBM) describing the study. Patients who did not opt-out from further contact were contacted by telephone (n = 1317) to arrange a meeting with a study staff member in the clinic waiting room before their clinic visit. Nine hundred and fifty-three of these patients (72.4%) provided informed consent and completed the study survey. Of those

who did not participate, approximately one-third declined; 25% either did not arrive for their appointment, promised to complete the survey at home but did not, or could not be reached. One-quarter were either did not have diabetes or were excluded due to illness or inability to participate due to mental illness.

We assessed 909 patients with type 2 diabetes at baseline and re-contacted a subset of the initial sample for repeated survey administration, approximately 9 months later. We started with patients who were contacted earliest for the baseline survey with a goal of re-evaluating 150 patients at each clinic. We reached 138 participants from the community health center and 157 from the hospital-based primary care internal medicine practice. For the current analysis, we limited our analyses to 208 participants who had complete data on all study variables at baseline and follow-up. Average time to follow-up for these participants was 8.91±2.32 months. Those who were included in the current analysis did not differ significantly from those who were not contacted or otherwise not included because of missing data on any variables included in the current analyses at baseline. They also did not differ significantly in age, duration of diabetes, gender, or baseline body mass index (BMI).

Survey instruments

Assessment of Depression—We used the 10-item Harvard Department of Psychiatry/ National Depression Screening Day Scale (HANDS) to assess symptoms of major depression over the previous two weeks. This scale is scored from 0-30 with a score of 9 or greater having a sensitivity of at least 95% and specificity between 60%-94% for major depression, depending on sample characteristics. Validation studies reported by Baer and colleagues demonstrated that HANDS specificity and sensitivity indices for major depression were equal to or greater than those for longer self-report measures [18]. The HANDS was administered at baseline and follow-up and had an internal reliability coefficient alpha of 0.88 and 0.87 at each time point, respectively.

Assessment of Self Care—To measure diabetes self-management, we used a modified version of the Summary of Diabetes Self-Care Activities questionnaire (SDSCA) [19,20]. This scale assesses the frequency with which each patient followed a diabetes self-care routine over the previous 7 days in five domains: diet, exercise, self-monitoring of blood glucose (SMBG), foot care, and medication adherence. For diet, the scale assesses adherence to general diet with two items and contains three additional items related to specific dietary recommendations: eating five or more servings of fruits and vegetables, eating high fat foods, and a supplemental question about spacing carbohydrates evenly throughout the day. These items were examined separately, as recommended by the authors [20], due to low inter-item correlations. To assess medication adherence, we asked patients the following question: “In the past seven days, on how many days did you miss taking any one of your prescribed medicines?” For this item, we dichotomized responses into “any missed doses” and “no missed doses.” SDSCA and medication adherence items were administered at baseline and follow-up.

Demographic and clinical covariates

Demographic data were derived from survey responses. Clinical data were collected from notes reviews, directly from electronic medical records, billing claims, and administrative records. Charlson comorbidity scores were calculated based on presence of comorbidities in medical records [21].

Data Analysis

Descriptive statistics were calculated for all study variables; all variables were approximately normally distributed. We used depressive symptom severity, as measured by

the HANDS total score, as our primary predictor based on our previous findings indicating that a continuous measure of depression symptom severity is a superior predictor of self-care to a categorical measure [12]. Time (in months) between baseline and follow-up was entered as a covariate in each model. Charlson comorbidity score (marker of severity of illness comorbidity) and prescription of insulin (marker of diabetes treatment intensity) were entered as covariates in each model to avoid confounding between illness severity and depression.

Linear regression models were used to determine if baseline depression symptom severity (HANDS total score) was a predictor of follow-up self-care, with covariates entered on the first step. Logistic regression tested depression symptoms at baseline as a predictor of medication nonadherence at follow-up, after covariates were entered. We then repeated each of these sets of analyses adding the appropriate baseline self-care variable on the first step, as an additional covariate. While change scores have been recommended as dependent variables in analysis of change in between-group designs [22], conditional change models that control for Y_1 when predicting Y_2 have been recommended as more appropriate for panel data, especially when the objective is to establish evidence for directionality of a relationship, rather than to model individual change [23]. Finally, to separate the independent contribution of baseline depression from possible changes in depression over time, we repeated these conditional change models, adding change in HANDS score ($HANDS_{\Delta}$ = follow-up HANDS - baseline HANDS) to each model.

To estimate effect sizes for linear regression effects presented below, we use the formula $r = \beta + 0.05\lambda$, where λ is an indicator variable that equals 1 when β (standardized beta) is nonnegative and 0 when β is negative. This formula accurately estimates the effect size r from β values -0.50 to 0.50, independent of sample size and number of covariates (24). Conventions for determine the magnitude of effect sizes in social science suggest that $r \leq 0.10$ are small, $r = 0.25$ are medium, and $r \geq 0.40$ are large (25). All data were analyzed using SPSS 15.0. (SPSS Inc., Chicacgo, Ill).

RESULTS

Baseline Descriptive Data and Changes in Depression Over Time

Participant characteristics are reported in Table 1. Approximately 86% of participants were White, 7% were Black, and 3% were Hispanic/Latino. Remaining participants were from other backgrounds. At baseline, 18% ($\underline{n}$ =37) met HANDS criteria for probable diagnosis of major depression (HANDS ≥ 9), 70% reported at least some depressive symptoms without meeting HANDS criteria for probable major depression (HANDS 1-8), and 12% reported no depressive symptoms (HANDS score = 0). At follow-up assessment, 22% of participants met screening criteria for major depression, and 64.9% reported at least some depressive symptoms.

HANDS scores at baseline and follow-up were highly correlated ($\underline{r}$ =0.77; $\underline{p} < 0.001$). Participants who met HANDS screening criteria at baseline were very likely to also meet screening criteria at follow-up, an average of 9 months later. Approximately 81% ($\underline{n}$ = 30) of participants who met screening criteria at baseline also met criteria for probable major depression at follow-up. The great majority (91%) of patients who did not meet criteria at baseline also did not meet criteria at follow-up.

Depressive Symptoms Predicting Self-care

We first examined the prospective relationship between baseline HANDS score and subsequent SDSCA-scales (first and second data columns in Table 2). Results from linear regression models showed that higher baseline HANDS scores significantly predicted worse

adherence to general dietary recommendations, less spacing of carbohydrates, lower consumption of fruits and vegetables, less exercise, less frequent SMBG, and worse foot care at follow-up. Effect size *r*s for these relationships were each equal to the respective β, within rounding. Baseline HANDS scores did not predict high-fat food consumption at follow-up ($r = 0.11$). Logistic regression showed that higher baseline levels of depressive symptoms significantly predicted medication nonadherence ($p = 0.003$). For each one-point increase in baseline HANDS score, there was a 1.10-fold increase in odds of medication nonadherence at follow-up (95%CI = 1.034-1.177).

We next examined baseline depressive symptom severity as a predictor of follow-up self-care in conditional change models controlling for baseline levels of self-care (third and fourth data columns in Table 2). In these models, higher baseline levels of depressive symptoms were predictive of worse adherence to general dietary recommendations, lower fruit and vegetable consumption, less spacing of carbohydrates, less exercise, and less frequent foot care. Baseline depression did not predict changes in high fat food consumption. The relationship between baseline depression scores and follow-up SBGM was in the expected direction but short of significance ($p = 0.072$). Logistic regression again showed that higher baseline levels of depressive symptoms significantly predicted medication nonadherence at follow-up even after controlling for baseline nonadherence ($p = 0.047$). For each one-point increase in baseline HANDS score, there was a 1.08-fold increase in odds of nonadherence to medications at follow-up (95%CI = 1.001-1.158).

Finally, we examined the independent contributions of baseline depressive symptom severity ($HANDS_b$) and change in depressive symptoms from baseline to follow-up ($HANDS_\Delta$) in predicting follow-up self-care in conditional change models (fifth and sixth data columns in Table 2). Independent of any change in depression over time, higher baseline levels of depressive symptoms remained significantly predictive of worse adherence to general dietary recommendations, lower fruit and vegetable consumption, less spacing of carbohydrates, less exercise, less frequent foot care, and medication nonadherence. Increases in depressive symptoms significantly predicted worse adherence to general dietary recommendations, less spacing of carbohydrates, increased consumption of high fat foods, and less exercise, independent of baseline level of depressive symptoms.

DISCUSSION

In a longitudinal sample of primary care patients with type 2 diabetes, we found that symptoms of depression assessed at baseline prospectively predicted poorer adherence to various aspects of diet (except consumption of high-fat foods), exercise, glucose monitoring, foot care, and prescribed medication recommendations at follow-up, an average of 9 months later. Thus, the relationship between depressive symptoms and poorer diabetes self-care is robust and we found significant evidence for this relationship across a wide range of diabetes self-care behaviours, even with substantial time lag between measurement of depressive symptoms and subsequent measurement of diabetes self-care. It is possible that the SDSCA item assessing high-fat food consumption is problematic because it gives “red meat” and “full-fat dairy products” as the only two examples of high fat foods. This item may not capture other sources of high fat (e.g., fried foods, fast food).

With the exception of glucose monitoring ($p = 0.072$), the relationship between baseline depression and subsequent diabetes self-care behaviours remained significant after controlling for baseline levels of self-care. This pattern of results extends our previous cross-sectional findings in a larger sample of primary care patients with type 2 diabetes [12]. To our knowledge, this is the first report to examine depressive symptoms as a prospective predictor for a complete set of self-care behaviours in patients with diabetes. Using

conditional change models allowed us to obtain evidence for the directionality of this relationship [23]. These models are conservative in that they control for baseline self-care, thus ruling out the potential indirect relationship between baseline depression and subsequent self-care through baseline levels of self-care. Hence, our results make a novel contribution to the literature on depression and self-care in diabetes by showing that even if shared variance between symptoms of depression and self-care at baseline is controlled, depression continues to exert a direct effect on subsequent self-care, measured an average of 9 months later. Furthermore, results from additional models including change in depressive symptoms over time suggest that the observed relationship between baseline depressive symptoms and follow-up self-care is not an artifact of unremitted depressive symptoms present at the follow-up time point.

This study has several strengths that improve upon methods of previous reports. We analyzed a primary care sample to examine the prospective relationship between depression and a complete set of self-care behaviours important for the management of type 2 diabetes, using well-validated measures of self-care and depression (i.e., the SDSCA and the HANDS). One previous report used a prospective design to examine the relationship between depression symptoms, a composite of medication adherence, adherence to dietary guidelines, and patients' perceived concordance between their self-care and clinician recommendations [13]. These authors also found that depression symptoms predicted lower levels of self-care and adherence over time. Results from the current study compliment these findings by examining a wider rage of self-care behaviours and controlling for baseline levels of self-care.

Our results must be interpreted in the context of the study design. While use of a prospective design did allow us to examine baseline depressive symptoms as a predictor of subsequent self-care, designs using more than two waves of data would more fully explore issues of directionality and causality. Future work with multi-wave datasets is needed to fully elucidate the directionality and possible causal nature of these relationships. Self-care and adherence behaviours were all measured via self-report and there is likely to be bias in such measures. Future investigations using more objective measures of self-care are needed. In addition, the lack of racial and ethnic heterogeneity limits generalizability of these findings to other ethnic and racial backgrounds.

Our findings suggest that depressive symptoms have a negative impact on important parameters of diabetes self-care over time. While the extent to which treating depression in diabetes patients would result in improved self-care remains unclear, it is likely that symptoms of depression such as decreased energy and concentration, increased feelings of hopelessness and worthlessness, and loss of pleasure and interest would negatively impact on patients' ability to adhere to the difficult self-care routines required to successfully manage type 2 diabetes. It is important to consider that symptoms of depression that occur in the context of diabetes have important relationships with the experience of the illness. For example, in a sample of patients with diabetic peripheral neuropathy, presence of diabetes complications, severity of neuropathy, symptoms of neuropathy such as pain and unsteadiness, beliefs about treatment control and unpredictability of symptoms, and changes in activities and social roles due to the illness were each associated with increased symptoms of depression [26]. Therefore, interventions that treat depression without attending to contextual determinants of these symptoms in patients with diabetes may be less effective in influencing diabetes outcomes.

While the relationship between depressive symptoms and poorer self-care of diabetes appears to be robust, our results indicate that the size of this effect is in the small to medium range. Thus, our findings underscore the need for population-based interventions. Existing

educational and self-management interventions for patients with diabetes might also be successfully adapted to include psycho-education for depression and training in distress management skills. Given the high prevalence of depressive symptoms in patients with diabetes, such cost-effective interventions aimed at improving recognition and management of depressive symptoms could have important effects on self-care and glycaemic control. This possibility deserves examination in well-powered randomized controlled trials.

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References

1. Anderson RJ, Freedland KE, Clouse RE, Lustman PJ. The prevalence of comorbid depression in adults with diabetes: a meta-analysis. Diabetes Care. 2001; 24:1069–1078. [PubMed: 11375373]
2. Barnard KD, Skinner TC, Peveler R. The prevalence of co-morbid depression in adults with Type 1 diabetes: systematic literature review. Diabet Med. 2005; 23:445–448. [PubMed: 16620276]
3. Ali S, Stone MA, Peters JL, Davies MJ, Khunti K. The prevalence of co-morbid depression in adults with Type 2 diabetes: a systematic review and meta-analysis. Diabet Med. 2006; 23:1165–1173. [PubMed: 17054590]
4. Gavard JA, Lustman PJ, Clouse RE. Prevalence of depression in adults with diabetes. Diabetes Care. 1993; 16:1167–1178. [PubMed: 8375247]
5. Katon WJ, Rutter C, Simon G, Lin EH, Ludman E, Ciechanowski P, Kinder L, Young B, Von Korff M. The association of comorbid depression with mortality in patients with type 2 diabetes. Diabetes Care. 2005; 28:2668–2670. [PubMed: 16249537]
6. Lustman PJ, Anderson RJ, Freedland KE, Groot MD, Carney RM, Clouse RE. Depression and poor glycemic control: a meta-analytic review of the literature. Diabetes Care. 2000; 23:934–942. [PubMed: 10895843]
7. de Groot M, Anderson R, Freedland KE, Clouse RE, Lustman PJ. Association of depression and diabetes complications: a meta-analysis. Psychosom Med. 2001; 63:619–630. [PubMed: 11485116]
8. DiMatteo MR, Lepper HS, Croghan TW. Depression is a risk factor for noncompliance with medical treatment meta-analysis of the effects of anxiety and depression on patient adherence. Arch Intern Med. 2000; 160:2101–2107. [PubMed: 10904452]
9. Ciechanowski PS, Katon WJ, Russo JE. Impact of depressive symptoms on adherence, function, and costs. Arch Intern Med. 2000; 160:3278–3285. [PubMed: 11088090]
10. Ciechanowski PS, Katon WJ, Russo JE, Hirsch IB. The relationship of depressive symptoms to symptom reporting, self-care and glucose control in diabetes. Gen Hosp Psychiatry. 2003; 25:246–252. [PubMed: 12850656]
11. Lin EH, Katon W, Von Korff M, Rutter C, Simon GE, Oliver M, Ciechanowski P, Ludman EJ, Bush T, Young B. Relationship of depression and diabetes self-care, medication adherence, and preventative care. Diabetes Care. 2004; 27:2154–2160. [PubMed: 15333477]
12. Gonzalez JS, Safren SA, Cagliero E, Wexler DJ, Delahanty L, Wittenberg E, Blais MA, Meigs JB, Grant RW. Depression, Self-Care, and Medication Adherence in Type 2 Diabetes: Relationships across the full range of symptom severity. Diabetes Care. 2007; 9:2222–7. [PubMed: 17536067]
13. Kalsekar ID, Madhaven SS, Amonkar MM, Makela EH, Scott VG, Douglas SM, Elswick BL. Depression in patients with type 2 diabetes: Impact on adherence to oral hypoglycemic agents. Ann Pharmacother. 2006; 40:605–611. [PubMed: 16551768]
14. McKellar JD, Humphreys K, Peitte JD. Depression increases diabetes symptoms by complicating patients' self-care adherence. Diabetes Educ. 2004; 30:485–492. [PubMed: 15208846]
15. Grant RW, Cagliero E, Chueh HC, Meigs JB. Internet use among primary care patients with type 2 diabetes: the generation and education gap (Abstract). J Gen Intern Med. 2005; 20:A470.

16. Delahanty LM, Grant RW, Wittenberg E, Bosch JL, Wexler DJ, Cagliero E, Meigs JB. Association of diabetes-related emotional distress with diabetes treatment in primary care patients with type 2 diabetes (Abstract). Diabet Med. 2007; 24:A48.

17. Wexler DJ, Grant RW, Wittenberg E, Bosch JL, Cagliero E, Delahanty L, Blais MA, Meigs JB. Correlates of health-related quality of life in type 2 diabetes. Diabetologia. 2006; 49:1489–1497. [PubMed: 16752167]

18. Baer L, Jacobs DG, Meszler-Reizes J, Blais M, Fava M, Kessler R, Magruder K, Murphy J, Kopans B, Cukor P, Leahy L, O'Laughlen J. Development of a brief screening instrument: The HANDS. Psychother Psychosom. 2000; 69:35–41. [PubMed: 10601833]

19. Toobert DJ, Hampson SE, Glasgow RE. The summary of diabetes self-care activities measure: results from 7 studies and a revised scale. Diabetes Care. 2000; 23:943–950. [PubMed: 10895844]

20. Toobert, DJ.; Glasgow, RE. Handbook of psychology & diabetes: Assessing diabetes self-management: The Summary of Diabetes Self-Care Activities Questionnaire. Bradley, C., editor. Berkshire, UK: Harwood Academic; 1994.

21. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. J Chron Dis. 1987; 40:373–383. [PubMed: 3558716]

22. Allison PD. Change scores as dependent variables in regression analysis. Sociol Methodol. 1990; 20:93–114.

23. Finkel, SE. Causal Analysis with Panel Data. Thousand Oaks, CA: Sage; 1995.

24. Peterson RA, Brown SP. On the use of beta coefficients in meta-analysis. J Appl Psych. 2005; 90:175–181.

25. Cohen, J. Statistical power analysis for the behavioral sciences. 2. Hillsdale, NJ: Erlbaum; 1988.

26. Vileikyte L, Leventhal H, Gonzalez JS, Peyrot M, Rubin RR, Ulbrecht JS, Garrow, Waterman C, Cavanagh PR, Boulton AJM. Diabetic Peripheral Neuropathy and Depressive Symptoms. Diabetes Care. 2005; 10:2378–2373. [PubMed: 16186266]

Table 1

Baseline Clinical Characteristics

Demographics and health variables (N = 208)	
HANDS Total Score	5.2±5.0
Sex	
Female	49%
Male	51%
Clinic Site	
Hospital-based	55.3%
Community Clinic	44.7%
Education	
Less than high school diploma	19.3%
High school diploma, its equivalent, or some college	59.4%
Four years of college or advanced degree	21.3%
Age (years)	65.5±11.6
Duration diabetes (years)	9.4±6.9
Charlson Comorbidity	3.2±1.8
Total number of Medications	1 (1-18)
Insulin	
Yes	26.9%
No	73.1%

N, %, mean±SD or median (range)

Table 2

Regressions results predicting self-care at follow-up from HANDS at baseline

Follow-up Self-Care Measure	Baseline HANDS predicting follow-up Self-Care		Baseline HANDS predicting Follow-up Self-Care with Baseline Self-Care controlled^		Baseline and Change in HANDS predicting Follow-up Self-Care with Baseline Self-Care controlled^	
	β or OR(95%CI)*	p value	β or OR(95%CI)*	p value	β or OR(95%CI)*	p value
General Diet	-0.27	< 0.001	-0.17	0.007	$HANDS_b$ = -.25 $HANDS_\Delta$ = -.21	< 0.001 0.001
Fruits and Vegetables	-0.26	< 0.001	-0.18	0.004	$HANDS_b$ = -.21 $HANDS_\Delta$ = -.10	0.002 0.143
Spacing Carbohydrates	-0.29	< 0.001	-0.23	0.001	$HANDS_b$ = -.28 $HANDS_\Delta$ = -.16	< 0.001 0.017
High Fat Foods	0.06	0.440	0.01	0.874	$HANDS_b$ = .06 $HANDS_\Delta$ = .15	0.390 0.036
Exercise	-0.20	0.004	-0.12	0.046	$HANDS_b$ = -.17 $HANDS_\Delta$ = -.14	0.009 0.036
Glucose Monitoring	-0.15	0.028	-0.09	0.072	$HANDS_b$ = -.10 $HANDS_\Delta$ = -.01	0.082 0.885
Foot Care	-0.17	0.015	-0.12	0.036	$HANDS_b$ = -.15 $HANDS_\Delta$ = -.07	0.018 0.247
Medication Nonadherence†	1.10 (1.03-1.18)	0.003	1.08 (1.001-1.16)	0.047	$HANDS_b$ = 1.09 (1.01-1.18) $HANDS_\Delta$ = 1.05 (0.93-1.19)	0.030 0.401

Note: $HANDS_b$ = HANDS baseline total score; $HANDS_\Delta$ = change in HANDS total score from baseline to follow-up.

*Each of these models included number of months between baseline and follow-up assessments, Charlson comorbidity score, and prescription of insulin as covariates.

^Each of these models also controlled for the relevant measure of baseline self-care entered on the first step of the regression model.

†Total number of prescribed medications was not significantly related to medication adherence at follow-up and including this variable as an additional covariate produced essentially identical results (data not shown).