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Self-care Behavior Change and Depression among Low-income Predominantly Hispanic Patients in Safety-net Clinics

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Abstract

This study examined whether changes in self-care behaviors during a 12-month period predicted the likelihood of screening positive for depression concurrently and prospectively among low-income Hispanic patients with diabetes. Secondary analyses were conducted with longitudinal data collected from a randomized controlled trial that had tested effectiveness of collaborative depression care. We examined whether changes in self-care behaviors observed during the 12 months after baseline predicted the likelihood of screening positive for depression at 12-, 18-, and 24-month follow-up. Self-care behaviors included healthy diet, exercise, self-blood glucose monitoring, and foot care, which were measured by a validated self-reported instrument. Logistic regression analyses indicated that patients with more frequent healthy diet during the 12 months after baseline had significantly lower likelihood of depression. Patients with more frequent exercise had a lower likelihood of screening for depression at 18- and 24-month follow-up. No significant association was found with self-blood glucose monitoring, and foot care. These findings suggest the importance of integrated care that emphasizes healthy diet and exercise, together with traditional depression treatment, when helping low-income Hispanic patients with diabetes and comorbid depression.

Keywords

self-care behaviors; healthy diet; diabetes; comorbid depression; exercise

Introduction

Patients with diabetes are frequently asked to engage in self-care behaviors by health doctors and nurses. Healthy diet, exercise, self- blood glucose monitoring (SBGM), and foot care are widely recognized behaviors for successful diabetes management (American Diabetes Association, 2014). Patients with diabetes who adhere to recommended self-care behaviors show improvement in health outcomes (Early, Shultz, & Corbett, 2009; Egede & Osborn, 2010; Manders, Van Dijk, & Van Loon, 2010; Swift, Johannsen, Earnest, Blair, & Church, 2012). Adherence to recommended self-care behaviors is correlated with mental comorbidities, particularly comorbid depression (Egede & Osborn, 2010; Lin et al., 2004;

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McKellar, Humphreys, & Piette, 2004). Therefore, different successful depression treatments for diabetes patients have been developed and tested (Ell, Katon et al., 2010; Katon et al., 2010; Katon et al., 2004; J. W. Williams et al., 2004). However, existing literature focusing on individuals without diabetes has suggested that relationships between depressive symptoms and self-care behaviors are likely to be bidirectional, particularly exercise. For instance, Conn (2010) conducted a meta-analysis of 60 published and unpublished studies and found that exercise regimens or interventions have a .372 effect size on depression outcomes. To extend our knowledge, we studied self-care behaviors' role associated with depression among diabetes patients using longitudinal data.

Comorbid Depression and Health Outcomes among Diabetes Patients

Comorbid depression is significantly associated with diabetes outcomes by virtue of shared biological pathways, emotional burdens associated with disease progression, and distress associated with self-care behaviors (Fisher, Chan, Nan, Sartorius, & Oldenburg, 2012; Katon, 2003; Katon et al., 2010). Patients simply receiving a diagnosis of type 2 diabetes had a 70% increased risk of clinical depression compared to patients who were unaware of having diabetes (Golden et al., 2008; Knol et al., 2007). In empirical studies, depressive symptoms were positively correlated with an increased likelihood of having micro- and macrovascular complications, worse diabetes symptoms, and challenges with glycemic control (Coleman, Katon, Lin, & Von Korff, 2013; Egede & Hernández-Tejada, 2013). Worse progression of diabetes among patients with comorbid depression translates into increased risk of mortality. For instance, after controlling for demographic attributes, patients diagnosed with major depression at baseline had a 1.97 times greater mortality rate in 10 years, compared to diabetes patients without depression diagnosis at baseline (Coleman et al., 2013). Another study found evidence consistent with the previous study that showed clinical depression is associated with increased mortality compared to individuals who didn't meet the cutoff score for clinical depression (Park, Katon, & Wolf, 2013). Thus comorbid depression is viewed as a major comorbidity to be treated in primary care among diabetes patients (Ell, Aranda, et al., 2010; Katon et al., 2010; Katon et al., 2004; J. W. Williams et al., 2004).

Bidirectional Relationship between Comorbid Depression and Self-Care Behaviors

Self-care behaviors, such as exercise and healthy diet, have been examined to understand the negative influence of comorbid depression on diabetes and health outcomes (Katon, 2003; Katon et al., 2010). Diabetes patients are encouraged to adhere to self-care behaviors, although these behaviors vary based on disease progression. In general, the Summary of Diabetes Self-Care Activities (SDSCA) has been used in clinical trials testing depression care for diabetes patients and measures self-care behaviors, including healthy diet, exercise, SBGM, foot care, smoking, and others (Toobert & Glasgow, 1994; Toobert, Hampson, & Glasgow, 2000). Observational studies consistently showed significant correlations between self-care behaviors and depressive symptoms (DiMatteo, Lepper, & Croghan, 2000; Gonzalez et al., 2008; Hernandez et al., 2016; Sumlin et al., 2014). DiMatteo et al. (2000) conducted a meta-analysis of correlational studies that examined associations between depression and adherence to self-care behaviors, finding a medium effect size. Another systematic review of studies published after 2000 found that only two of 20 studies and two of 15 studies did not demonstrate significant relationships between depression and healthy diet and exercise, respectively (Sumlin et al., 2014). Such lower adherence to self-care behaviors correlated with depression can be explained by various behaviors that manifest alongside a depression diagnosis. Individuals with depression often manifest a loss of interest in routine tasks associated with their lack of motivation to follow recommended self-care behaviors and medication use (Padala et al., 2008). Reduced motivation to implement recommended self-care behaviors due to symptoms of depression is likely to impair overall health (Gonzalez et al., 2007). Patients with depression may lose positive expectations, experience helplessness (Nagelkerk, Reick, & Meengs, 2006), and struggle to mobilize social support due to isolation commonly observed among patients with depression (DiMatteo, 2004). Loss of cognitive functioning is an additional symptom of depression that could contribute to suboptimal self-care behaviors (DiMatteo et al., 2000; J. A. Wagner, Tennen, & Osborn, 2010). However, psychology related to implementing self-care behaviors could increase depression risk (Markowitz, Gonzalez, Wilkinson, & Safren, 2011). Emotional consequences of failure to adhere to a self-care plan, such as diabetes-related burden, have been found to increase depression risk (Lloyd, Roy, Nouwen, & Chauhan, 2012). Patients with diabetes often express concern associated with implementing prescribed self-care behaviors and describe feeling guilty when the management plan is not implemented (Delahanty et al., 2007). Patients report higher depressive symptoms when they are unable to execute recommended self-care behaviors, which may result in negative emotions, such as concern about their uncertain health status and fear of diabetes complications (Zagarins, Allen, Garb, & Welch, 2012).

However, few studies have examined whether self-care behaviors affect depressive symptoms among diabetes patients diagnosed with depression. Exercise has been consistently found to be correlated with depressive symptoms concurrently and predictively in observational studies among individuals without diabetes (Arent, Landers, & Etnier, 2000). Thus we expected that Hispanic patients who engaged in more frequent exercise would demonstrate lower depression risk. This study focused on whether changes observed in self-care behavior are predictive of changes in depressive symptoms using prospective data from a clinical trial testing effectiveness of collaborative depression care among low-income Hispanic patients with diabetes (Ell, Katon et al., 2010). In another study, we investigated whether depression remission observed at 12-month follow-up was associated with more frequent self-care behaviors 6 and 12 months later (Oh & Ell, 2016). Based on previous studies supporting the bidirectional nature of this relationship, we expect to see that better self-care behaviors would correlated with lower depressive symptoms.

Methods

Sample and Procedure

The Multifaceted Depression Diabetes Program (MDDP) was conducted in two safety-net primary care clinics in Los Angeles, California. MDDP tested the effectiveness of socioculturally adapted collaborative team depression care for low-income, predominantly Hispanic patients with type 2 diabetes. At study recruitment, 30.2% of participants were found to have depression based on the Patient Health Questionnaire (PHQ-9). Among eligible patients, 78.7% of them chose to participate in the MDDP ($N = 387$; Ell, Katon et al. 2010). The eligible 387 patients were randomly assigned into either an intervention or enhanced usual care group. Patients assigned to the intervention group received either antidepressant medications, problem-solving therapy, or both therapies according to a stepped-care algorithm in which first-line and subsequent depression treatment is determined by telephone treatment response, adherence, and relapse prevention (Ell, Katon et al., 2010). Among patients assigned to the intervention group, 58.5% received antidepressants and 79.3% participated in problem-solving therapy or other counseling services during the 18-month follow-up. Patients assigned to the enhanced usual care group received psychoeducational materials for depression and diabetes management and results from their depression screening were sent to their primary care physician in the safety-net clinic where recruitment took place.

We conducted secondary analyses of data from the MDDP. Specifically, we analyzed data from patients who participated at the 12-month follow-up assessment ($n = 281$; 72.6% of the total sample) to examine whether changes in self-care behaviors at 12 months compared to baseline were associated with depression measured at 12-month follow-up. We also examined correlations between changes in self-care behaviors for the same period and depression measured at 18- and 24-month follow-up. Thus we analyzed data from patients who completed both 12- and 18-month follow-up ($n = 249$; 64.3% of the total sample) or who completed both 12- and 24-month follow-up ($n = 235$; 60.7% of the total sample). By conducting three models with different temporal relationships, we maximized the richness of data collected from a multiwave study to examine relationships between self-care behavior change and depression from different viewpoints.

Table 1 demonstrates findings from group comparisons between patients whose data were and weren't analyzed in terms of depression remission status at 12- ($n = 281$), 18- ($n = 249$), and 24-month ($n = 235$) follow-up. These comparisons helped explicate the extent to which attrition was driven by any predisposing factors of participating patients. For group comparisons, chi-square analyses for categorical variables and independent samples t-tests for continuous variables were conducted. Regarding analysis involving outcomes measured at 12-month follow-up, only the proportion of Spanish-only speaking patients was higher in the analytic sample ($p < .05$), among all demographic and clinical characteristics. Group comparisons demonstrated that no significant difference in demographic characteristics was observed between samples with depression outcomes at 18- and 24-month follow-up. However, group comparisons showed that SBGM at baseline was significantly different between analyzed groups and dropouts among those with depression outcome measured at 24-month follow-up ($p < .05$). Overall, the three samples used in the analyses did not experience disproportionate attrition correlated with baseline demographic and clinical characteristics, except for several anomalies.

Measures

We examined healthy diet, exercise, SBGM, and foot care as self-care behaviors that are crucial for diabetes patients. The SDSCA was used to quantify the extent to which patients implemented these recommended self-care behaviors during the previous week (Toobert &

Glasgow, 1994; Toobert et al., 2000). The SDSCA has been used to quantify implementation of diabetes self-care in many clinical trials that examined the effectiveness or efficacy of mental health services (Ell, Katon et al., 2010; Katon et al., 2010; J. W. Williams et al., 2004). Evidence has supported the SDSCA's reliability and concurrent validity with other instruments related to self-care behaviors (Toobert & Glasgow, 1994; Toobert et al., 2000). The SDSCA asks participants to recall how many times they implemented specific self-care behaviors accepted as good or bad related to healthy diet, exercise, SBGM, and foot care during a previous week when they didn't have acute symptoms. Toobert et al. (2000) recommended that each domain focusing on a single self-care behavior should be analyzed independently because previous psychometric examinations demonstrated ostensibly low correlations among subdomains. Because each item asks for the number of days during the previous week during which respondents implemented a specific behavior, the mean of items in each subdomain indicates the frequency of recommended self-care behaviors implemented by patients. Scores range from 0 (*lowest*) to 7 (*highest*). Due to few items in subdomains, mostly two questions each, it is not recommended to calculate internal consistency, or Cronbach's alpha, for each self-care behavior.

To assess risk of depression, we used the standard cutoff (≥ 10) of the PHQ-9. The PHQ-9 was developed to increase the capacity of primary care providers to detect and monitor clinical depression (Kroenke & Spitzer, 2002; Löwe, Kroenke, Herzog, & Gräfe, 2004; Spitzer, Kroenke, & Williams, 1999). Previous studies have noted its broader applicability to groups of different races, ethnicities, ages, and languages (Huang, Chung, Kroenke, Delucchi, & Spitzer, 2006; Wittkampf, Naeije, Schene, Huyser, & van Weert, 2007). Patients were asked to assess how often they experienced emotional states—0 = *not at all*, 1 = *several days*, 2 = *more than half of all days*, and 3= *nearly every day*—and answers from nine items were summed for scoring. Final scores can range from 0 to 27. Regarding internal consistency of our three datasets, Cronbach's α was .83, .83, and .84 for analysis involving depression measurement at 12-, 18-, and 24-month follow-up, respectively.

First, we examined crude differences between patients who screened positive for depression and those who didn't using the PHQ-9 cutoff (≥ 10). Comparisons of the mean and distribution of proportions were conducted with respect to demographic and clinical factors at baseline and changes in self-care behaviors during the 12 months following baseline. For these analyses, chi-square analyses and independent sample *t*-tests were conducted depending on the measurement of each attribute.

Finally, logistic regression analyses were conducted to examine correlations between changes in self-care behaviors during the 12 months after baseline and likelihood of screening positive for depression at 12-, 18-, and 24-month follow-up, generating odds ratios (*OR*s; with 95% confidence intervals, or CIs) of likelihood of depression when the predictor's value changes by 1 unit. The analyses controlled for demographic and clinical variables at baseline that could confound associations between self-care behaviors and depression, including age (< 50 vs. 50+ years), study groups (intervention vs. usual care), education, gender, marital status, dysthymia at baseline, PHQ-9 score at baseline, primary language (Spanish vs. English only or bilingual), and receiving insulin treatment at baseline. Some patients who scored very high or low in self-care behaviors might generate a ceiling or bottom effect. Thus we also controlled for baseline values of these variable. As a sensitivity analysis, we also conducted linear regression analyses with severity of depressive symptoms as the dependent variable (see Appendix for full results). In this analysis, the coefficient for each parameter, standard error (*SE*), and significance level of the *t*-test were reported in the results. To indicate statistical significance, $p < .05$ was used. For data analysis, SPSS version 21.0 was used.

Results

Table 2 shows associations between demographic and clinical characteristics at baseline and differences in the frequency of each self-care behavior between baseline and 12-month follow-up and likelihood of screening positive for depression. Proportions of patients with positive screenings were 33.5% ($n = 94$), 38.6% ($n = 96$), and 35.7% ($N = 84$) among patients who completed 12-, 18- and 24-month follow-up, respectively. These proportions showed a dramatic decline in proportion of patients who screened positive for depression compared to baseline when all patients scored higher than the cutoff score. The likelihood of screening positive for depression was lower among patients assigned to the intervention group at 18-month follow-up, but no difference was found at 12- and 24-month follow-up. No demographic factors were correlated with the depression outcome at 12- and 18-month follow-up. Findings from bivariate analyses showed that patients who only speak Spanish ($p < .01$), were less educated ($p < .001$), and were not married ($p < 01$) were more likely to screen positive for depression at 24-month follow-up . In addition, having dysthymia and depressive symptoms at baseline were consistently correlated with higher likelihood of screening positive at 12-, 18-, and 24-month follow-up. When examining group differences in self-care during the 12 months since baseline, no significant difference was observed ($p > .05$).

Table 3 shows findings from logistic regressions that examined associations between changes in self-care behaviors during the 12 months since baseline and the likelihood of screening positive for depression at 12-, 18-, and 24-month follow-up after controlling for baseline depressive symptoms and other confounders. Patients who had a 1-unit increase or an additional day of consuming a healthy diet between baseline and 12-month follow-up were 0.82 times less likely to screen positive for depression ($p < .05$). Patients who improved their adherence to a healthy diet during the previous 12 months were less likely to screen positive for depression. Analyses of depression outcome measured at 18- and 24-month follow-up demonstrated that change in exercise predicted lower likelihood of screening positive for depression ($p < .05$). Patients who engaged in an additional day of exercise each week during the 12 months since baseline were 0.82 and 0.84 times less likely to screen positive for depression at 18 and 24 months, respectively ($p < .05$). However, we didn't find significant associations between other self-care behaviors and likelihood of depression. We conducted supplemental analyses that regressed interval-level depressive symptoms on the set of predictors used for the primary analysis. Linear regression analyses demonstrated consistent findings; depressive symptoms were negatively correlated with changes in healthy diet ($p < .01$) at 12-month follow-up and exercise at 18- ($p < .01$) and 24-month ($p < .01$) follow-up (see Appendix for full results from linear regression analyses).

Discussion

Findings from our study are consistent with literature that self-care behaviors have a bidirectional relationship with depressive symptoms among patients with diabetes. Our data suggest that not all self-care behaviors predict risk of significant depression, which was measured with the PHQ-9 in this study (Spitzer et al., 1999). Only patients who reported more frequent healthy diet and exercise demonstrated lower risk of being screened for depression. Patients who reported more frequent SBGM or foot care didn't have correlations with likelihood of screening positive for depression. In addition, correlations differed by time frame. Specifically, changes in healthy diet at 12 months predicted lower risk of depression, whereas exercise changes at 12 months predicted lower depression risk at 18- and 24-month follow-up. We believe that further studies should replicate and expand on our study because these inconsistent relationships might be driven by different mechanisms linking each self-care behavior and depression. Our findings support the provision of integrated care in community health centers that serve low-income Hispanics with diabetes and comorbid mental health (Markowitz et al., 2011). For diabetes patients, simply treating clinical depression may not be the best option given that healthy diet and exercise could negatively affect depression. A randomized controlled trial testing the effectiveness of integrated self-management training for patients with diabetes or heart illness and mental comorbidity demonstrated that integrating therapeutic activities to either improve self-care behaviors or treat depression demonstrated significant benefits regarding self-care behaviors, physical health outcomes, and depression (Katon et al., 2010). Another study found that depression remission in depression care doesn't necessarily improve self-care behaviors (Oh & Ell, 2016). Thus additional studies with samples gathered from different populations and secondary analyses of data collected in clinical trials are imperative (Sumlin et al., 2014).

Exercise had fairly robust effect sizes for risk of depression in prospective studies, and this finding is consistent with previous studies that demonstrated a significant decline in depressive symptoms after participants received interventions offering exercise support (Arent et al., 2000; Rhyner & Watts, 2016). This benefit of improving exercise might occur via different mechanisms, such as reducing the risk of experiencing diabetes complications (Lin et al., 2010), improving the immune system (Swift et al., 2012) and significant physiological metrics (e.g., A1C, or glycated hemoglobin; Macdonald, Philp, Harrison, Bone, & Watt, 2006; P. T. Williams, 2008), or even through neurotransmitters believed to be shared between exercise and depressive symptoms (Rethorst, Landers, Nagoshi, & Ross, 2010). Practice guidelines recommend exercise as one of the most effective approaches to treating depression among patients with diabetes (Dunn, Trivedi, & O'Neal, 2001; Fisher et al., 2012). Cognitive behavioral therapy often involves encouraging patients to activate behavioral changes, such as going outside for exposure to the sun or engaging in moderate physical activities, and these behavioral changes have been associated with lower depressive symptoms (Ryba, Lejuez, & Hopko, 2014). Thus providers should encourage patients to increase their exercise frequency when clinical depression is reported. However, low-income racial and ethnic minority patients can have difficulty engaging in exercise.

Although a significant correlation between healthy diet change and risk of depression was observed in the model with 12-month follow-up, the same relationship was not observed in models with either 18 or 24-month follow-up. This absence may be due to the fact that the greater likelihood of having a healthy diet may be an outcome of a reduction in depressive symptoms, rather than a cause of decreased depressive symptoms. The causal role of depression in poor dietary habits is fairly well established, although several moderators affect the association (O'Connor & Conner, 2011). Significant associations observed in the current analysis could hint at the existence of confounding variables. One relevant variable might be social support. Social support buffers psychological stress that contributes to depression and maintaining a healthy diet (Early et al., 2009; King et al., 2010; Pollard, Zachary, Wingert, Booker, & Surkan, 2014; Wen, Shepherd, & Parchman, 2004). A qualitative study involving interviews with Latino patients showed that quality of diet was largely affected by quality of relationships with their families and important friends, because what patients can eat is often affected by those with whom they eat (Pollard et al., 2014). In addition, patients with diabetes had to negotiate with family members to continue their healthy diet, because other family members don't always cooperate with their food choices (Early et al., 2009). It is possible that patients with high depressive symptoms experienced difficulty when negotiating with family members, because symptoms manifested among depression patients may trigger interpersonal conflicts (Hammen, 2006). As a result, depression may increase the risk of discordance with family members and result in reduced social support (Hickey et al., 2005). This phenomenon has been observed among patients with diabetes (Sacco & Yanover, 2006). Thus future research should determine whether social support nullifies the observed significant association between health diets change and depression risk in our study.

SBGM and foot care did not have a significant effect on concurrent and future depressive symptoms. It is uncommon to find no correlation between depression and these self-care behaviors, because changes in those self-care behaviors are often driven by consultation with health professionals rather than patients themselves (Katon et al., 2010). However, our findings should be cautiously interpreted because relationships between SBGM and foot care and depression might be modified by predisposing factors. For instance, a study that analyzed cross-sectional data gathered from adolescents with type 1 diabetes found that depressive symptoms and SBGM are significantly correlated (McGrady, Laffel, Drotar, Repaske, & Hood, 2009). A significant correlation between SBGM and likelihood of screening positive for depression was also witnessed in a cross-sectional study that analyzed data from type 2 diabetes patients in primary care clinics (Gonzalez et al., 2007). Regarding foot care, a small randomized controlled trial ($N = 30$) that recruited diabetes patients with diabetic foot syndrome from an inpatient hospital demonstrated that depressive symptoms and foot-related issues dropped concurrently after participants received psychotherapy, hinting at a correlation between foot care and depression risk among patients with foot-related diabetes complications (Simson et al., 2008). These findings suggest potentially more complex relationships between SBGM and foot care and depression, and further studies that examine different patterns in these associations among groups in different contexts are necessary.

Although nuanced, we believe that overall findings regarding self-care behaviors and depression among low-income patients with diabetes emphasize the importance of psychosocial programs that embrace both lifestyle support components and depression care

(Markowitz et al., 2011). It is not uncommon that interventions focusing on comorbid depression demonstrate trends of improvement in self-care behaviors together with treated comorbid depression, although significant differences between intervention and control groups have not been consistently observed (Ell, Katon et al., 2010; Katon et al., 2010; Katon et al., 2004; J. W. Williams et al., 2004). It is also not surprising to observe unexpected improvement in mental health or depressive symptoms in programs exclusively focused on enhancing diabetes management or self-care behaviors (Lorig, Ritter, Villa, & Armas, 2009; Lorig, Ritter, Villa, & Piette, 2008). Self-care management training provided by either a peer leader or automated telephone calls for 6 weeks aimed at reinforcing self-care behaviors were found to significantly reduce distress related to health, increase the frequency of self-care behaviors, and improve diabetes outcomes (Lorig et al., 2008). Another diabetes management program targeting multiple self-care behaviors showed significantly reduced depressive symptoms among participants compared to those assigned to a control group (Lorig et al., 2009), although the extent of improvement was smaller than in studies primarily focusing on clinical depression (Ell, Katon et al., 2010; Katon et al., 2010; Katon et al., 2004). However, empirical efforts to shed light on the complicated relationships between self-care behaviors and depression in integrated care settings, wherein treatments for both mental and physical health are offered, are lacking.

Although interesting findings were observed, we must note several limitations associated with our research methods, particularly related to conducting secondary analyses. First, nonprobability sampling was used for the original randomized controlled trial, and thus findings are not generalizable to all low-income Hispanic patients with diabetes and comorbid depression. In addition, this study was conducted in safety-net clinics mostly serving low-income and Hispanic individuals, resulting in limited application to other groups based on socioeconomic status, race, and ethnicity. In addition, because we relied on data about self-care behaviors from a self-reported instrument, other ways of gathering data about self-care behaviors should be adopted to examine validity of our findings. Third, using data gathered from a clinical trial in which depression was the primary outcome might affect the interval validity of our findings. Specifically, the magnitude of changes in self-care behaviors might be relatively smaller than lifestyle interventions because the MDDP did not focus on self-care behavior improvement (Minet, Møller, Vach, Wagner, & Henriksen, 2010; J. W. Williams et al., 2004). Thus secondary analysis of data gathered from other clinical trials testing the effectiveness of a lifestyle intervention likely would show different effect sizes and even direction of associations. Finally, multiple hypothesis testing with depression outcomes collected at three time points could artificially increase the probability of finding significant associations. When Bonferroni adjustment was made to the rejection level (α = .017), findings did not differ substantially compared to current findings.

To deepen our understanding of associations between self-care behaviors and depression among diabetes patients, more studies should examine samples of different demographic populations or contexts (e.g., intervention research; Sumlin et al., 2014). This study provides evidence of the importance of integrating lifestyle self-management and depression care into a single program, an approach consistent with the chronic care model (E. H. Wagner et al., 2001).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Comparison of demographic and clinical characteristics at baseline survey between patients who analyzed and who dropped out.

	12 months			**18 months**			**24 months**		
	Analyzed (*N* = 281)	Drop-outs (*N* = 106)		Analyzed (*N* = 249)	Dropouts (*N* = 138)		Analyzed (*N* = 235)	Dropout (*N* = 152)	
	***N* (%)**		***p***	***N* (%)**		***P***	***N* (%)**		***p***
Demographic Characteristics									
Age≥50	206 (73.3%)	73 (68.9%)	.39	183 (73.5%)	96 (69.6%)	.41	170 (72.3%)	109 (71.7%)	.89
Intervention group	142 (50.5%)	51 (48.1%)	.67	128 (51.4%)	65 (47.1%)	.42	124 (52.8%)	69 (45.4%)	.16
Female	234 (83.3%)	84 (79.2%)	.36	206 (82.7%)	112 (81.2%)	.70	198 (84.3%)	120 (78.9%)	.18
Only Spanish speaking	**244 (86.8%)**	**83 (78.3%)**	**.04**	217 (87.1%)	110 (79.7%)	.05	204 (86.8%)	123 (80.9%)	.12
Education									
Less than high school graduate	236 (84.0%)	81 (76.4%)	.18	211 (84.7%)	106 (76.8%)	.13	194 (82.6%)	123 (80.9%)	.83
High school graduates	32 (11.4%)	16 (15.1%)		27 (10.8%)	21 (15.2%)		29 (12.3%)	19 (12.5%)	
Above high school	13 (4.6%)	9 (8.5%)		11 (4.4%)	11 (8.0%)		12 (5.1%)	10 (6.6%)	
Marital status			.62			.52			.49
Married	142 (50.5%)	49 (46.2%)		128 (51.4%)	63 (45.7%)		121 (51.5%)	70 (46.1%)	
Separated	104 (37.0%)	45 (42.5%)		91 (36.5%)	58 (42.0%)		85 (36.2%)	64 (42.1%)	
Never married	35 (12.5%)	12 (11.3%)		30 (12.0%)	17 (12.3%)		29 (12.3%)	18 (11.8%)	
Baseline Clinical Characteristics									
Dysthymia	158 (56.2%)	56 (52.8%)	.55	141 (56.6%)	73 (52.9%)	.48	132 (56.2%)	82 (53.9%)	.67
On insulin treatment	78 (27.8%)	29 (27.4%)	.94	71 (28.5%)	36 (26.1%)	.61	65 (27.7%)	42 (27.6%)	.99
	Mean (*SD*)		***p***	**Mean (*SD*)**		***p***	**Mean (*SD*)**		***p***
PHQ-9	14.59 2.88)	15.05 3.13)	.18	14.62 2.87)	14.89 3.10)	.39	14.57 2.85)	14.94 3.10)	.23
Diet	4.25 (1.74)	4.34 1.90)	.64	4.22 1.73)	4.37 (1.89)	.43	4.25 (1.71)	4.30 (1.91)	.80
Exercise	2.03 (2.37)	1.87 2.34)	.55	2.03 2.35)	1.90 (2.38)	.58	2.04 (2.33)	1.90 (2.41)	.57
SBGM	2.77 (2.82)	2.35 2.75)	.19	2.75 2.79)	2.48 (2.82)	.36	**2.88 (2.86)**	**2.30 (2.69)**	**.05**
Foot care	4.99 (2.79)	4.81 2.86)	.57	5.05 2.74)	4.74 (2.92)	.30	4.96 (2.80)	4.92 (2.83)	.87

Note:

Table 2

Demographic and clinical status depending on the status of depression among patients examined in analyses involving 12-, 18-, and 24-month follow-up

	12 months (N=281)			18 months (N=249)			24 months (N=235)		
	Screened positive (PHQ-9 ≥ 10) for depression								
	Yes 94 (33.5%)	No 187 (66.5%)		Yes 96 (38.6%)	No 153 (61.4%)		Yes 84 (35.7%)	No 151 (64.3%)	
	***N* (%)**		***p***	***N* (%)**		***P***	***N* (%)**		***p***
Demographic Characteristics									
Age ≥50	69 (33.5%)	137 (66.55)	.98	69 (37.7%)	114 (62.3%)	.65	64 (37.6%)	106 (62.4%)	.33
Intervention group	40 (28.25)	102 (71.8%)	.06	**40 (31.3%)**	**88 (68.8%)**	.02	47 (37.9%)	77 (62.1%)	.47
Female	73 (31.2%)	161 (68.8%)	.07	79 (38.3%)	127 (61.7%)	.89	68 (34.3%)	130 (65.7%)	.30
Only Spanish	77 (31.6%)	167 (68.4%)	.08	85 (39.2%)	132 (60.8%)	.60	**66 (32.4%)**	**138 (67.6%)**	**.01**
Education									
Less than high school	74 (31.4%)	162 (68.6%)	.23	81 (38.4%)	130 (61.6%)	.88	**61 (31.4%)**	**133 (68.6%)**	**.00**
High school graduates	14 (43.8%)	18 (56.3%)		10 (37.0%)	17 (63.0%)		**14 (48.3%)**	**15 (51.7%)**	
Above high school	6 (46.2%)	7 (53.8%)		5 (45.5%)	6 (54.5%)		**9 (75.0%)**	**3 (25.0%)**	
Marital status									
Married	44 (31.0%)	98 (69.0%)	.57	44 (34.4%)	84 (65.6%)	.25	**37 (30.6%)**	**84 (69.4%)**	**.01**
Separated	36 (38.3%)	68 (65.45)		37 (40.75)	54 (59.3%)		**29 (34.1%)**	**56 (65.9%)**	
Never married	14 (40.0%)	21 (60.0%)		15 (50.0%)	15 (50.0%)		**18 (62.1%)**	**11 (37.9%)**	
Baseline Clinical Characteristics									
Dysthymia	**62 (39.2%)**	**96 (60.8%)**	**.02**	**72 (51.15)**	**69 (48.9%)**	**.00**	**62 (47.0%)**	**70 (53.0%)**	**.00**
On insulin treatment	28 (35.9%)	50 (64.1%)	.59	28 (39.4%)	43 (60.6%)	.86	27 (32.1%)	38 (58.5%)	.25
	Mean (*SD*)		***p***	**Mean (*SD*)**		***p***	**Mean (*SD*)**		***p***
PHQ-9	**15.46 (2.69)**	**14.16 (2.88)**	**.00**	**15.07 (2.56)**	**14.34 (3.02)**	**.04**	**15.19 (2.50)**	**14.23 (2.98)**	**.01**
Diet	4.03 (1.68)	4.36 (1.77)	.14	4.25 (1.61)	4.20 (1.80)	.83	4.02 (1.58)	4.38 (1.77)	.12
Exercise	1.76 (2.26)	2.16 (2.41)	.18	1.88 (2.20)	2.13 (2.44)	.42	1.82 (2.07)	2.16 (2.46)	.29
SBGM	2.46 (2.76)	2.92 (2.84)	.20	2.86 (2.82)	2.68 (2.78)	.62	2.93 (2.79)	2.84 (2.90)	.82
Foot care	4.87 (2.80)	5.05 (2.79)	.61	4.92 (2.62)	5.14 (2.82)	.53	5.17 (2.60)	4.84 (2.91)	.38
Δ diet (0–12m)	.02 (1.99)	.30 (1.80)	.24	.00 (1.86)	.38 (1.84)	.12	.31 (1.93)	.35 (1.79)	.87
Δ exercise (0–12m)	.20 (2.83)	.36 (3.01)	.67	−.07 (2.87)	.51 (2.95)	.13	−.07 (2.41)	.54 (3.13)	.10
Δ BGSM (0–12m)	.27 (2.76)	−.13 (3.04)	.28	−.32 (2.92)	.09 (2.82)	.28	.26 (2.77)	−.19 (3.15)	.28
Δ foot care (0–12m)	−.37 (3.11)	−.23 (3.14)	.73	−.41 (3.24)	−.33 (2.99)	.85	−.33 (2.95)	−.10 (3.15)	.57

Note:

Table 3

Relationship between change of self-care behaviors for 12 months comparative to baseline data and likelihood of positively screened with depression (PHQ-9 ≥10) at 12-, 18-, and 24-month follow-up

	12 months (*n* = 281) *OR* (95% CI)	**18 months (*n* = 249) *OR* (95% CI)**	**24 months (*n* = 235) *OR* (95% CI)**
50>=age (ref: age <50)	1.09 (.55–2.16)	.75 (.37–1.53)	1.73 (.78–3.80)
Intervention group (ref: Usual care)	**.35 (.19-.64)**	**.37 (.20-.68)**	.65 (.34–1.24)
Lower than High school (ref: high school graduate)	.47 (.18–1.25)	.95 (.34–2.71)	.47 (.16–1.37)
Above than High school (ref: high school graduate)	.72 (.16–3.19)	1.17 (.24–5.82)	1.57 (.28–8.67)
Female (ref: male)	.48 (.23–1.00)	.81 (.37–1.78)	.81 (.34–1.92)
separated (ref: currently married)	1.25 (.67–2.35)	1.49 (.77–2.90)	.94 (.46–1.92)
Never married (ref: currently married)	1.62 (.67–3.92)	2.17 (.84–5.61)	**5.14 (1.93–13.68)**
Having dysthymia	1.55 (.86–2.78)	**3.61 (1.92–6.78)**	**2.65 (1.36–5.15)**
only Spanish speaking (ref: speaking English)	.88 (.33–2.37)	1.48 (.49–4.50)	.70 (.23–2.11)
Taking Insulin	1.07 (.55–2.08)	.87 (.43–1.74)	1.06 (.51–2.19)
Baseline PHQ-9 Score	**1.20 (1.08–1.33)**	1.10 (.99–1.22)	**1.13 (1.02–1.27)**
Diet at baseline	.83 (.66–1.04)	1.02 (.80–1.29)	.86 (.67–1.12)
Exercise at baseline	.87 (.73–1.04)	**.82 (.68–1.00)**	.85 (.70–1.04)
SBGM at baseline	.97 (.84–1.12)	1.00 (.86–1.17)	1.07 (.91–1.26)
Feet care at baseline	.95 (.80–1.14)	.94 (.78–1.14)	1.11 (.90–1.38)
Δ diet (0–12m)	**.82 (.67–1.00)**	.97 (.78–1.20)	.97 (.76–1.23)
Δ exercise (0–12m)	.92 (.81–1.06)	**.82 (.71-.96)**	**.84 (.72-.98)**
Δ SBGM (0–12m)	1.07 (.94–1.23)	.97 (.85–1.12)	1.11 (.95–1.29)
Δ foot care (0–12m)	.94 (.80–1.10)	.98 (.83–1.16)	1.02 (.83–1.24)
Nagelkerke R Square	.211	.237	.287

Note:. *OR*, odds ratio; *SE*, standard error; CI, confidence interval.