

The Effects of a Web-Based Intervention on Psychosocial Well-Being Among Adults Aged 60 and Older With Diabetes

A Randomized Trial

Gail E. Bond, PhD, RN

Robert L. Burr, MSEE, PhD

Fredric M. Wolf, PhD

Karen Feldt, PhD, ARNP

From the College of Nursing, Seattle University, Seattle, Washington (Dr Bond, Dr Feldt); Department of Biobehavioral Nursing and Health Systems, University of Washington, Seattle (Dr Burr); and Department of Biomedical and Health Informatics, University of Washington, Seattle (Dr Wolf).

Correspondence to Gail E. Bond, RN, PhD, Seattle University, College of Nursing, Box 222000, 901 12th Ave, Seattle, WA 98122-1090 (bondg@seattleu.edu).

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Purpose

The purpose of this study is to investigate the impact of a 6-month Web-based intervention on the psychosocial well-being of older adults with diabetes.

Methods

This study was a randomized controlled trial (N = 62) comparing the effects of a 6-month Web-based intervention plus usual care with usual care alone among adults aged 60 years or older with diabetes. The outcomes included quality of life, depression, social support, and self-efficacy.

Results

The intervention group showed significant improvement, $F(4.48) = 4.03$ $P = .007$, when compared with the control group on measures of depression, quality of life, social support, and self-efficacy when controlling for all baseline outcome variables (age, gender, and number of years with diabetes).

Conclusions

These findings provide support for the conclusion that a Web-based intervention is effective in improving the

psychosocial well-being of participants at a 6-month follow-up. Future research needs to investigate the long-term effectiveness of Web-based interventions for sustaining psychosocial well-being, including factors that may affect quality of life, such as diabetes-specific beliefs, attitudes, social support, and disease-specific coping skills.

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People with diabetes experience psychosocial challenges that can affect their life significantly.^{1,2} Despite advances in treatment regimens now available for care, the self-management activities of diabetes remain complex, with treatment recommendations difficult to incorporate into existing lifestyles.^{2,3} The daily management of diabetes can be overwhelming.⁴ Many emotional factors play an important role in diabetes care. People with diabetes often experience high levels of diabetes-related emotional distress as they manage fluctuating blood glucose levels, which can result in poor self-management due to feelings of “diabetes burnout.”^{4,5} A significant number of patients with diabetes who have participated in research report being depressed,⁶⁻⁸ and depression is twice as high among persons with diabetes as compared with those who do not have diabetes.⁶ Depression and the feelings associated with depression can interfere with self-care management activities and affect glycemic control, which can lead to increased risks of morbidity and greater health care costs.^{4,9-11} Because people with diabetes use a disproportionately greater share of health care resources and the associated costs, the investigation into nontraditional ways to help treat the disease appears more than warranted.¹²

The proliferation of the Internet, in conjunction with the advent of new health care technologies, has enabled caregivers to target people with diabetes and other chronic conditions, with the hope of improving their quality of life and psychosocial well-being through means of remote access.^{13,14} Several particularly promising areas of innovation have emerged, including online support groups, online communities, e-mail, access to health care advice and information, and electronic bulletin boards.^{15,16} One especially attractive feature of Internet-based support groups involves how individuals with chronic illnesses or disabilities might find it more convenient to participate in an online format rather than having to

attend meetings in person.¹⁷ The question of whether online support interventions can be effective in providing social support and lower feelings of depression as compared with face-to-face interactions is particularly compelling for Internet-based support interventions since they rely exclusively on interactions that are not face to face.^{15,18,19}

Research regarding the investigation of the potential effects of the Internet on the psychosocial well-being of adults with diabetes and other chronic illness continues to emerge. Researchers have used various forms of a Web-based intervention (transmission of data, e-mail, accessing health-related educational information, or online support groups) with a variety of chronic conditions, including diabetes, asthma, depression, congestive heart failure, osteoarthritis, pain, and HIV.^{18,20-23} These investigations suggest that Web technology may improve quality of life, reduce feelings of social isolation and depression, and increase social support for adults with chronic care demands.^{20,24-26} Taken together, these studies indicate that the Internet may provide a feasible alternative for the delivery of health care to such individuals. The purpose of this study, therefore, is to investigate the impact of a 6-month Web-based intervention on the psychosocial well-being of older adults with diabetes. The specific hypothesis tested was that the group receiving the Web-based intervention would experience improvement with feelings of depression, feelings of social support, and quality of life and self-efficacy issues when compared with a group not receiving the intervention.

Methods

Eligibility and Exclusions

Criteria for inclusion were aged 60 years or older, a diagnosis of diabetes for at least 1 year, living independently in the community, and oral fluency in English. Exclusion criteria were moderate or severe cognitive, visual, or physical impairment or the presence of severe comorbid disease (end-stage renal disease, blindness, terminal illness). No prior computer experience was required. Individuals were eligible regardless of A1C level.

Study Design

Subjects were enrolled through the University of Washington Diabetes Center, Puget Sound Health

System, and local diabetes fairs held in the greater Seattle area. A total of 67 participants responded to flyers, provider referral, or letters sent to potential subjects from members of the Washington State Diabetes Registry. Screening for eligibility was conducted by telephone prior to the baseline examination. Eligible subjects were then contacted by mail and telephone and invited to attend the baseline examination where informed consent was obtained. To ensure overall balance, participants were randomized using a stratified 2-tier format based on glycosylated hemoglobin (A1C) level (above and below 7.5 [median cut]) and gender. Subjects were recruited to participate in 1 of 2 phases, with the first phase ($n = 31$) beginning September 2004 and ending September 2005. The second phase started February 2005 and ended February 2006. Subjects assigned to the intervention group who did not have access to a computer were provided one. An appointment was made by telephone for the installation of the study computer equipment, and subjects were given training to use the equipment. A follow-up examination was conducted at 6 months after the baseline examination. Personnel conducting these examinations were blinded to intervention status and were not involved in supporting the technical aspects of the intervention or in delivering diabetes case management services. The study also provided access to the Internet if an intervention participant did not have a means of access. This study was approved by the Institutional Review Board at the University of Washington.

Intervention

The intervention was designed for and delivered via the Internet, and it emphasized the patient's role in maintaining health and the importance of setting goals and using problem-solving skills to overcome barriers. The primary objective was to improve the participants' diabetes self-management behaviors and psychosocial well-being. Intervention strategies included using behavioral and motivational strategies, using cues to modify perceptions of self-efficacy, and using cues to modify personal beliefs regarding the subject's ability to affect the progress of the disease and change his or her personal behavior. The intervention served as an adjunct to the usual care provided by the subject's provider. The primary care physicians of the intervention patients retained full responsibility and control over the patients' care. Additional strategies included instruction in disease

management, diet, and exercise and the introduction of interventions to deal with the physical and emotional demands of the disease.

The interaction between the study nurse and the intervention participants occurred using both synchronous communication (instant messaging and chat) and asynchronous communication (e-mail and a bulletin board). In addition, participants accessed a study Web site to enter their blood glucose readings, exercise programs, weight changes, blood pressure, and medication data. The study nurse accessed participants' logs to monitor changes in their self-management patterns. As part of the intervention, the study nurse contacted the participant via e-mail or through instant messenger and/or chat when there were changes in blood glucose patterns that needed problem solving to resolve. The weekly online educational discussion group treatment component served 2 purposes: (1) to provide educational material and (2) to promote peer support and social interaction through sharing of each person's personal experiences in dealing with their diabetes. The formal weekly discussion group was delivered by the principal investigator through a weekly online communication forum using MSN Messenger software provided by Microsoft Corp (Redmond, WA). The content for these weekly educational discussion sessions was developed using resources available from the National Institute of Health, American Diabetes Association, and the Joslin Center. The sessions related to depression, burnout, and coping were led by either an MSN social worker or a PhD psychologist. In addition to the weekly formal discussion sessions, the participants had access to one another through e-mail and instant messaging. Participants could have real-time conversations when they were online and logged into MSN Messenger. These interactions were participant generated and not moderated by any study personnel. See Table 1 for a listing of the intervention resources provided as part of this study.

Control/Usual Care Group

Participants in the control group received their standard diabetes care from their provider. No educational or training materials associated with the intervention were provided to participants in the control group. Participants in the control group had access to educational materials/classes through traditional face-to-face classroom methods furnished by their health provider and/or via the

Table 1

Characteristics of the Study Web Site Resources

Access to a library of articles and sites on diabetes and other health-related topics
Receiving online advice, counseling, and encouragement from a nurse via e-mail
The ability to submit a personal log (database) of self-management activities performed
Receiving tailored self-management instruction from the study nurse regarding the development of personal action plans
The ability to participate in biweekly chat/discussion with a nurse-led peer support question-and-answer and problem-solving forum
An Internet bulletin board used to present the latest news in diabetes, to post diabetes management goals of participants, and to provide problem-solving suggestions to assist other study participants to better manage their diabetes, psychosocial well-being, and possible depression
The ability to submit a daily log of diabetes self-management activities (blood glucose levels, medication administration, meal intake, weight, and blood pressure)

Internet. Internet usage for both groups was assessed during the study.

Outcome Measures

Psychosocial outcome measures included depression, social support, quality of life, and self-efficacy. Depression was assessed using the Center for Epidemiological Studies Depression Scale (CES-D).²⁷ The CES-D is a 20-item self-report measure that assesses frequency of depressive symptoms during the preceding 2 weeks. The ratings of depressive symptoms range from 1 (*rarely*) to 4 (*occasionally or moderate*). Scores of 16 or higher are considered indicative of depression. The CES-D has been found to be sensitive to change over time.²⁸ It also shows good reliability ($\alpha = .92$; test-retest reliability = 0.54) and validity ($r = 0.44$ and 0.56) in comparisons with the Hamilton Depression Rating Scale and severity of depression ratings in older adults.^{27,29} In the current study, α was .90 for the CES-D, and test-retest reliability was 0.81.

In addition to depression, 3 other components of psychosocial well-being were examined (quality of life, self-efficacy, and social support). The Problem Areas in Diabetes Scale (PAID)³⁰ is a 20-item questionnaire that assesses emotional functioning and quality of life in people with diabetes. This instrument measures a wide range of feelings related to living with diabetes, lifestyle adjustments, quality of life, treatment, and distress. Each

item is rated on a 6-point Likert-type scale ranging from 1 (*no problem*) to 6 (*serious problem*). A total scale score is hypothesized to reflect the degree to which the item is perceived as currently problematic. The 20-item PAID has high internal consistency ($\alpha = .95$), and the first principal component from a factor analysis accounted for 52.5% of the variance across the set of all 20 items.³¹ Concurrent validity of the PAID scale was supported by correlations with the Health Belief Scale (-0.34), the Diabetes Social Support Scale (-0.47), and glycemic control (A1C [0.18]), with greater distress associated with poorer glycemic control.³¹ For the current study, α was .95, and test-retest reliability was 0.73.

The perception of diabetes-related social support was assessed using the Diabetes Support Scale.¹³ This 12-item measure assesses both social support received for diabetes care and the support exchanged in a computer-mediated intervention. The scale is balanced with 6 items worded positively (available support) and 6 items worded negatively (unavailable support). Six of the items refer to support that can be provided by anyone, while the other 6 items refer to support provided by another person with diabetes. Each item is scored on a 7-point scale ranging from *strongly agree* (1) to *strongly disagree* (7). The internal consistencies of the scale with subjects who participated in an Internet-based diabetes intervention study were 0.90 and 0.91.¹³ For the current study, α was .85 for internal consistency of this scale, and test-retest reliability was 0.57. The scale ratings also correlated significantly

with the number of times participants logged onto the Internet.^{14,24}

Self-efficacy was assessed using the Diabetes Empowerment Scale (DES).³² The DES is a 28-item self-report that measures the participant's self-efficacy related to (1) managing the psychosocial aspects of diabetes, (2) assessing readiness to change, and (3) setting and achieving diabetes treatment goals. The DES has high internal consistency ($\alpha = .96$) and test-retest reliability (0.79) and was found to be significantly correlated with the Diabetes Care Profile Index and A1C.³² In the current study, α was .92 for internal consistency of the DES, and test-retest reliability was 0.61.

Sample Size and Power Calculations

For planning purposes, the statistical power for the study was modeled by an independent groups *t*-test contrast of differences in pre-post change scores for a typical outcome variable or by the use of an analysis of covariance (ANCOVA) of a 6-month measure of an outcome variable by group, with the baseline measurement of that same outcome variable used as a linear covariate for statistical control. Assuming 62 total participants (31 per group), a 15% longitudinal attrition rate, an $r = 0.5$ correlation between premeasures and postmeasures of the outcome variable, and a moderate effect size ($d = 0.55$), the study was projected to have 80% predicted statistical power to detect a group difference in the primary outcomes. Moderate-to-large effect sizes and attrition rates in the 10% to 20% range have been reported in previous similar Web-based intervention studies.³³⁻³⁶

Statistical Analysis

The planned statistical analyses for this randomized intervention study were intended to evaluate treatment group differences in 4 psychosocial outcome variables (depression, quality of life, self-efficacy, and social support). To accommodate individual differences in each participant's initial scores, the analyses were controlled for baseline level of the variables using an ANCOVA approach. The analyses were also controlled for participant characteristics such as age, gender, number of comorbidities, and number of years diagnosed with diabetes.

The proposed study threshold for statistical significance was $\alpha = .05$. Because 4 outcome variables were to be tested, the worst-case possibility that 1 of the 4 tests would falsely appear to be significant just by chance

increases to about $P = .185$. To protect against this multiple-testing bias, a single analysis of the combined set of all 4 outcome variables was first conducted using a multivariate analysis of covariance (MANCOVA) procedure, statistically controlling for the baseline levels of the variables and patient characteristics. MANCOVA analysis results in a single P value that describes the probability that the observed group differences in the overall pattern of the 4 outcome variables could have happened by chance. This becomes the primary technical test of intervention effect in this study. For interpretability, individual ANCOVA results for each of the 4 outcome variables were also reported.

Additional exploratory analyses were also undertaken to evaluate group differences on interpretable subscales of several of the outcome measures and in subgroups of participants.

Results

The intervention and control group did not differ with respect to baseline demographic and clinical characteristics. See Table 2 for baseline demographics of the participants ($N = 62$), by group assignment. The mean age for the intervention group was 66 years ($SD = 5.7$) and for the control group was 68 years ($SD = 6.2$). The mean level of education was 15 years for both groups ($SD = 1.8$ and 2.2 , respectively). The 2 groups did not differ significantly on their amount of computer experience. One hundred percent of the treatment group and 89% of the control group had some experience with using a computer. In addition, the 2 groups did not differ significantly on any of the baseline psychosocial well-being variables (depression, social support, quality of life, and self-efficacy).

MANCOVA with the use of the Pillai criterion to evaluate the multivariate significance of the set of 4 dependent variables (depression, social support, quality of life, and self-efficacy), controlling for baseline depression, social support, quality of life, self-efficacy and age, number of comorbidities, and years since diagnosed with diabetes, showed a significant main effect related to group differences, $F(4, 48) = 4.03$ $P = .007$. The univariate ANCOVA F tests for the 4 individual outcome variables showed a significant ($P < .05$) difference for depression, social support, quality of life, and self-efficacy. See Table 3 and Figure 1 for the displayed statistics of before and after unadjusted means, covariate adjusted difference score, d statistic, and observed power and

Table 2

Demographic and Baseline Clinical Characteristics of Study Participants in the Study by Group Assignment (N = 62)

	Control (n = 31)	Treatment (n = 31)	<i>P</i> ^a value
Age, y (mean)	68.2 (6.2)	66.2 (5.7)	.178
Mean years of education	15.9 (2.2)	15.8 (1.5)	.887
Mean years with diabetes	17.8 (11.7)	16.1 (10.5)	.743
Annual income, %			
>\$40 000	48	47	.297
<\$40 000	52	53	
Gender, %			
Men	52	58	.399
Women	48	42	
Ethnicity, %			
Caucasian	86	87	.809 ^b
African American	10	4	
Native American	0	3	
Hispanic	0	3	
Other	4	4	
Computer experience, %			
None	13	0	.109 ^c
<6 mo	4	3	
1 y	3	5	
>1 y	80	92	
Marital status, %			
Married	62	55	.731
Single/divorced/widowed	38	45	

^aBased on χ^2 test for categorical variables and an independent groups *t* test for continuous variables.

^bBecause 8 of 10 of the cells in this cross-tabulation have expected counts less than 5, the convergence of the χ^2 approximation is uncertain, and the *P* value should be interpreted cautiously.

^cBecause 6 of 8 of the cells in this cross-tabulation have expected counts less than 5, the convergence of the χ^2 approximation is uncertain, and the *P* value should be interpreted cautiously.

confidence intervals. The standardized effect size *d* for the adjusted change on the 4 psychosocial outcomes ranged from 0.6 for self-efficacy ratings to 1.0 for social support favoring treatment over control for the 4 outcome measures.

Since the overall global test for self-efficacy on the DES was significant, a MANCOVA was conducted on the 3 subscales of the DES to further explore the impact

of the 6-month Web intervention on a specific area of self-efficacy: (1) managing the psychosocial aspects of diabetes, (2) assessing readiness to change, and (3) setting and achieving diabetes treatment goals. MANCOVA with the use of the Pillai criterion to evaluate the multivariate significance of the 3 subscales (dependent variables) controlling for the baseline 3 self-efficacy subscales, age, number of comorbidities, and number of

Table 3

Analysis of Covariance Comparing Psychosocial Outcomes for Treatment Versus Control Group at 6-Month Postintervention (N = 62)^a

	Baseline Unadjusted, Mean (SD)	6-Mo Unadjusted, Mean (SD)	Diff Score Adjusted, Mean (SD)	ES (<i>d</i>)	Observed Power	<i>P</i> Value
Depression (CES-D)						
Treatment (n = 31)	12.0 (10.4)	9.8 (7.9)	−0.23 (0.79)	0.7	0.71	<.05
Control n = 31)	11.1 (8.7)	12.1 (8.5)	−0.77 (0.83)			
Quality of life (PAID) ^b						
Treatment	2.3 (0.88)	2.0 (0.67)	−0.28 (0.93)	0.6	0.58	<.05
Control	2.1 (0.84)	2.2 (0.91)	0.02 (0.10)			
Self-efficacy (DES) ^b						
Treatment	2.2 (0.42)	2.0 (0.35)	−0.14 (0.05)	0.7	0.74	<.05
Control	2.1 (0.48)	2.2 (0.45)	0.08 (0.06)			
Social support						
Treatment	5.2 (0.82)	6.0 (0.70)	0.65 (0.12)	1.0	0.95	<.001
Control	5.6 (0.82)	5.5 (0.85)	0.00 (0.13)			

^aAnalytic results are based on univariate analyses of covariance of the 6-month score, controlling for the baseline score, age, gender, number of comorbidities, and number of years diagnosed with diabetes.

^bLower score at 6-month follow-up indicates improvement.

years since diagnosed with diabetes showed a significant main effect related to group differences, $F(3, 49) = 3.50$, $P = .035$. The univariate F tests obtained in the MANCOVA showed significant $P < .05$ difference for the subscales of “assessing readiness to change” and “achieving diabetes treatment goals” (data not shown).

Additional analyses were conducted to further explore the possible association between the psychosocial domains of depression, quality of life, self-efficacy, and social support with disease-specific variables known to influence the relationship between psychosocial well-being and treatment type in adults with diabetes.³⁷⁻⁴⁰ These variables included number of years with diabetes, number of comorbidities, and treatment type (insulin use, oral glycemic agent, no medication). A MANCOVA was conducted using the change scores on depression, quality of life, self-efficacy, and social support as the dependent variables and controlling for the individual characteristics (age, gender, marital status, A1C, education, and baseline score on the dependent variables). Number of

years with diabetes (more and less than 16 years), number of comorbidities (more and less than 6), treatment type (insulin use, oral glycemic agent, no medication), and group assignment (treatment versus control) were used as independent variables. Findings showed a significant main effect ($P < .05$) for treatment type, together with a significant main effect ($P < .05$) for depression and quality of life with regard to group assignment. There was no significant main effect for number of years with diabetes, number of comorbidities, or any other significant interactions. As can be seen in Figures 2 and 3, the participants in both groups (treatment and control) experienced the same pattern of change as the participants in the no-medication category. Their change scores on their depression and quality-of-life ratings, however, were much lower than that of the participants in the oral agent or insulin use group. Participants in the oral agent group showed the greatest improvements on their depression and quality-of-life scores, whereas insulin users also experienced improvements in their depression and

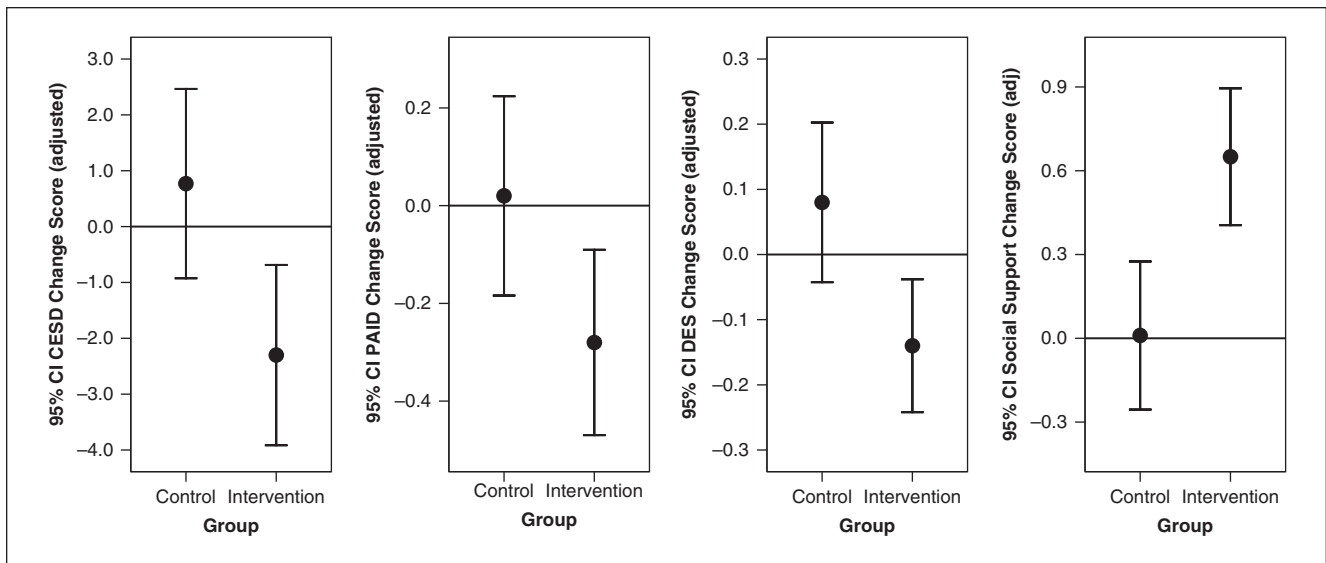


Figure 1. Mean \pm 95% confidence intervals for covariate-adjusted change scores from baseline to 6-months postrandomization for depression (Center for Epidemiological Studies Depression Scale), quality of life (Problem Areas in Diabetes Scale), self-efficacy (Diabetes Empowerment Scale), and social support. The solid horizontal bar in each figure represents the line of no change from pre to post. The change scores for each outcome variable were adjusted in a univariate analysis of covariance for a set of covariates that included the variables' baseline value and participant age, gender, number of comorbidities, and number of years diagnosed with diabetes. For all 4 psychosocial outcome variables, the 95% confidence interval of the intervention group excludes both the line of no change and the mean change of the control group.

quality-of-life scores, although not at the same magnitude as the oral agent users (data not shown).

Discussion

The purpose of this study was to investigate the impact of a 6-month Web-based intervention on the psychosocial outcomes associated with diabetes management. The specific hypothesis tested was that a 6-month Web-based intervention would improve the psychosocial well-being of the participants who received a 6-month Web-based intervention compared with a control group. Participants who received the Web intervention did improve on their depression, quality of life, self-efficacy, and social support ratings compared with the control group. Findings from this study also provide support for the premise that duration of diabetes, number of comorbidities, and glycemic control are not associated with quality of life and depression.

The type of diabetes treatment regimen, however, was associated with depression and quality-of-life outcomes. Participants who were in the no-medication group reported more depression and poorer quality of life than participants who were taking either an oral agent or insulin.

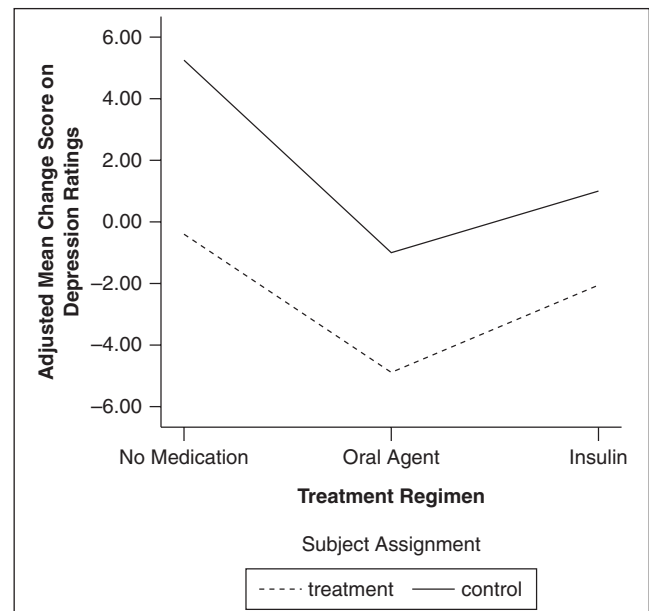


Figure 2. Adjusted 6-month mean change on depression ratings by treatment regimen (N = 62).

These findings seemed inconsistent with the literature.³⁷ Because diabetes is a disease that progresses over time, logic would suggest that participants in the no-medication

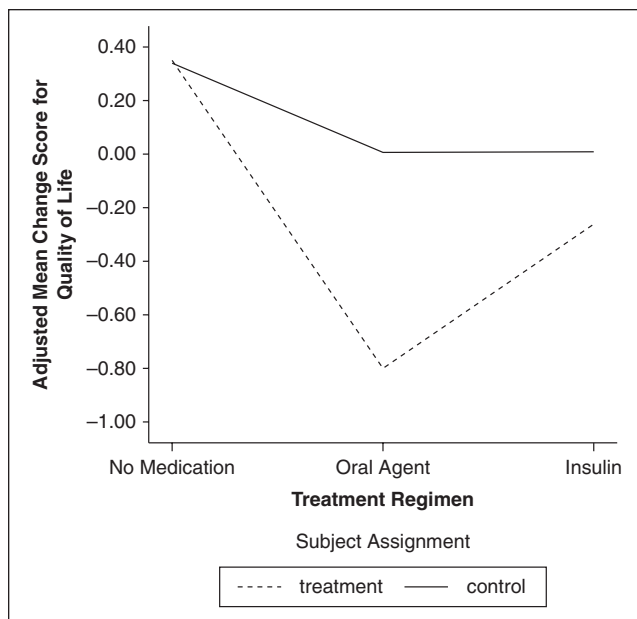


Figure 3. Adjusted 6-month mean change on quality-of-life ratings by treatment regimen (N = 62).

group should have better psychosocial well-being because their disease has not advanced to the point that they require medication intervention. In contrast, however, the average time period for establishing diagnoses of diabetes was 9.9 years for participants in the no-medication group compared with 8.9 years for participants in the oral agent group. Since insulin resistance and progression of insulin secretory dysfunction are major confounders of effective long-term glycemic management,⁴¹⁻⁴⁴ it is possible that participants in the no-medication group have to work harder (exercise more and eat a diet lower in carbohydrates to keep their blood glucose levels within the reference range compared with people who are currently taking an oral agent). This pressure to maintain normal blood glucose levels in light of the increasing unavailability of insulin could create a catch-22-type situation responsible for generating negative feelings about not being able to manage the disease as well as in the past. The initiation of medication is often delayed in patients with type 2 diabetes for several reasons, including a lack of resources in an office-based practice, fear of hypoglycemia, and provider and patient resistance to its use.^{45,46}

This study was limited to a small sample of older adults, who were mainly Caucasian, well educated, and earned an annual income greater than \$40 000. It did not look at the long-term effectiveness of the intervention. In

addition, since this was a multicomponent intervention, it was not possible to determine which aspect of the intervention was the most effective and contributed the most to changes in the psychological outcome measures. Furthermore, participants varied widely in how actively they used the Web site intervention components. As can also be inferred, this study lacked a diverse pool of participants in terms of race, socioeconomic status, and geographic location. Finally, the study sample was composed of a motivated group of volunteers with fairly good glycemic control who chose to enroll in an intervention study (all characteristics of patients motivated to engage in an appropriate regimen of self-care management).

In the light of these limitations, the findings of this study provide additional evidence regarding the effects of a Web-based intervention for improving depression, social support, self-efficacy, and quality of life in a sample of older men and women with diabetes. Web-based interventions to enhance self-confidence and social support may be important for assisting older adults to better manage their diabetes. In addition, Web interventions that link both physical and psychosocial well-being and social support (ie, peer and health care provider support) may be particularly relevant for adults with diabetes because of their potential contribution to improving both the physiological and psychosocial outcomes associated with diabetes. The interrelatedness of physiological and psychosocial adjustment in people with diabetes warrants further attention. Researchers and clinicians need to learn how can we design, implement, and evaluate Web-based interventions that influence factors that may affect quality of life and psychosocial well-being, including diabetes-specific beliefs and attitudes, social support, and disease-specific coping skills.

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