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PREDICTING DIABETES DISTRESS in PATIENTS WITH TYPE 2 DIABETES: A LONGITUDINAL STUDY

Lawrence Fisher, Ph.D., ABPP[1], **Joseph T. Mullan, Ph.D.**[2], **Marilyn M. Skaff, Ph.D.**[1], **Russell E. Glasgow, Ph.D.**[3], **Patricia Arean, Ph.D.**[4], and **Danielle Hessler, Ph.D**[1]

[1]Department of Family and Community Medicine, UCSF

[2]Department of Social and Behavioral Sciences, School of Nursing, UCSF

[3]Clinical Research Unit, Kaiser Permanente Colorado, Denver, CO

[4]Department of Psychiatry, UCSF

Abstract

OBJECTIVE—Diabetes distress (DD) is a condition distinct from depression that is related to diabetes outcomes. In those without distress initially, little is known about what indicators place patients at risk for subsequent distress over time.

RESEARCH DESIGN AND METHODS—From a community based, 3-wave, 18-month study of type 2 diabetic patients (N = 506), we identified patients with no DD at T1 who displayed DD at T2, T3 or both (N=57). Using logistic regression with full and trimmed models, we compared them to patients with no DD at all 3 time points (N = 275) on three blocks of variables: patient characteristics (demographics, depression, extra-disease stress), biological (HbA_{1c}, BMI, comorbidities, complications, blood pressure, non HDL cholesterol), and behavioural variables (diet, exercise). Selected interactions with stress and MDD were explored.

RESULTS—The odds of becoming distressed over time were higher for being female, previously having MDD, experiencing more negative events or more chronic stress, having more complications, and having poor diet and low exercise. Negative life events increased the negative effects of both high HbA_{1c} and high complications on the emergence of distress over time.

CONCLUSIONS—We identified a list of significant, independent direct and interactive predictors of high DD that can be used for patient screening to identify this high risk patient cohort. Given the impact of high DD on diabetes behavioural and biological indicators, the findings suggest the usefulness of regularly appraising both current life and disease-related stressors in clinical care.

INTRODUCTION

Previous studies have shown that most patients with diabetes who display high levels of depressive affect are not necessarily clinically depressed 1› 2; instead, they experience high levels of emotional distress stemming from concerns and worries associated with their diabetes and its management 1›3. In comparative analyses of a community sample of patients with type 2 diabetes, we showed a substantially higher point-prevalence of diabetes distress (DD) (18.0%) than of major depressive disorder (MDD) (10.7%); in addition, the analyses indicated a significant relationship between diabetes distress, HbA_{1c} and several

Corresponding author: Lawrence Fisher, Dept. of Family and Community Medicine, Box 0900, UCSF, San Francisco, CA 94143; phone = 415-476-5403; fax = 415-381-2939; email = fisherl@fcm.ucsf.edu.

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disease management measures, whereas no significant relationships were found in controlled analyses among MDD, depressive affect and these variables 1‚3. We concluded that although MDD and high depressive affect are prevalent, serious and treatable conditions in patients with diabetes, far more patients with diabetes display high levels of DD, and DD is more strongly linked with diabetes-related behavioural and biological variables than MDD or depressive affect.

Given the importance of DD and its associations with diabetes outcomes, we sought to identify those general patient, biological, behavioural and negative life event and chronic life stress characteristics that were associated with the later occurrence of high DD in patients with low DD at initial contact. Early identification of patients with diabetes at risk for high DD can lead to subsequent screening and follow-up care to reduce the emergence of high DD over time. Based on a 3-wave, 18-month, non interventional, longitudinal study of a community sample of 506 patients with type 2 diabetes, we identified patients with low DD at time one (T1) who subsequently displayed high DD 9 months later at T2 and/or 9 months after T2 at T3 (+DD group). These patients were compared to a second patient group with low DD at all three time points (−DD group). This strategy allowed us to identify unique predictors that distinguished between these two patient groups.

RESEARCH DESIGN AND METHODS

Subjects

Patients were recruited from several community medical groups and diabetes education centres. Inclusion criteria were: patient with type 2 diabetes; aged 21 to 75 years; able to read and speak English or Spanish fluently; no severe diabetes complications that reduced functionality (e.g., on dialysis, major amputations, other life-threatening illnesses); and no diagnosis of psychosis or dementia. Letters were sent to each patient from their health care facility, followed by a screening phone call. For eligible patients, an appointment was made in the patient's home, our office, or a community setting to explain the project, collect informed consent and begin assessment. At T1, patients received a 1.5-hour home visit that included questionnaires, physical measurements and interviews, a 150-item mail-back questionnaire, and a visit to a community laboratory for collection of blood and urine specimens. The same home-visit, questionnaire and community laboratory protocol was repeated at T2 and nine months later, at T3. Mean between-wave interval was 9.3 (SD=0.96) months. All materials were prepared in English and Spanish, and Research Assistants were fluent in both languages. Patients who met criteria for an affective or anxiety disorder and who were not being treated were referred to their physician. The project received approval from the UCSF Institutional Review Board and from the Boards of all collaborating institutions.

Measures

DD was assessed by the Diabetes Distress Scale (DDS),10‚ 11 a 17-item questionnaire (alpha = 0.93), with a mean-item score of ≥ 3 (moderate distress, 1–5 response scale) used as the distress cut-point 12. It was administered to patients at all three time points. Patients were classified as +DD if their DDS score at T1 was <3 and their DDS scores at T2 or T3 or both were ≥3. Those classified to the −DD group had DDS scores <3 at all three time points.

Three groups of variables were identified as potential predictors of becoming high DD. First, we identified a block of general patient characteristics that included patient age, sex, education, time since diagnosis, and self-identified ethnicity. MDD over the past year and extra-disease stress were also included because of their high prevalence among patients with diabetes and their potentially confounding effects on the primary variables under study.

MDD was assessed by the Composite International Diagnostic Interview, 4 a structured clinical interview. Both number of negative life events (NLE) and number of chronic stressors unrelated to health and diabetes currently experienced by the patient were also included. Life context stresses have been shown to affect glucose levels 5,6 and self-care behaviour 7, thus potentially generalizing to affect the emergence of high DD over time. Life stress was assessed by the Negative Life Events Scale (NLE) 8, based on a list of 22 potential stressful events such as the death of a friend, or being a crime victim; and the Chronic Stressors Scale 8, based on a list of 18 potential chronic, stressful situations such as having little money, living in a noisy neighbourhood, or having problems with children.

Second, patient biological variables included HbA_{1c}, BMI, number of co-morbidities, number of diabetes complications, diastolic and systolic blood pressure, and non HDL cholesterol. Third, patient behavioural variables included the diet and exercise components of the Summary of Diabetes Self-Care Activities 9. Each asks the respondent to indicate the number of days in the last week that they adhered to their diet (DIET) or exercise (EXERCISE) plan.

Data Analysis

Initial univariate comparisons between participating and refusing patients, between those who continued and those who dropped out over the three waves of assessment, and between high vs. low DD patients over time were undertaken using correlation, X^2 and Student's t tests. Using logistic regression analyses, our primary goal was to develop a parsimonious model of becoming distressed over time. Following Hosmer & Lemeshow, 13 we used a step-wise strategy to cull a small number of significant predictors across the three models: 8 general patient characteristics, 7 biological and 2 behavioural variables, with +/−DD as the dependent variable. Within each of the three models, we retained significant variables at $p < 0.10$. General patient characteristics were included in the analyses of the biological and behavioural variables to control for potential background influences. We then re-assessed each model, this time including only the already identified significant variables, using a backward selection method. Finally, we created and tested a combined model that included the best predictors from the final analysis of each of the three blocks of variables. At each stage we assessed for non-linear effects among continuous variables, multicollinearity, unusual changes in coefficients across analyses and large standard errors. The discriminatory ability and fit of the models were also assessed by examining the area under the ROC (C statistic) 13.

In exploratory analyses, interaction terms between potentially confounding variables (chronic and negative life event stress, previous MDD) and predictor variables were included as step two in each of the three separate analyses to determine if each stress score and MDD magnified or diminished the effects of the other predictors on +DD. Second, a trimmed model included only the interaction terms that reached or approached significance in that model. Third, a combined model included only the significant interaction terms across all three models, and to check for robustness, we also ran a model that included the significant interaction terms across all preceding analyses.

RESULTS

Analyses of patient non-participation and attrition have been presented previously 3. Briefly, screening identified 640 eligible patients, of whom 506 participated at T1 (79.0%). No differences between participants and non participants were found in demographic and diabetes-related variables. Of the 506 patients who completed T1, 411 (81.2%) completed all three study waves. Differences between completers vs. non completers occurred in only two of 28 comparisons: those who missed T2, T3 or both had longer duration of diabetes (r

= 0.12, p = 0.01) and more often spoke Spanish than English (r = 0.09, p = 0.04). Major reasons for dropping out were: moved out of area, new conflicting time demands.

Of the 332 patients in the cohort with low DD at T1, 57 (17.2%) reached criteria for +DD (Table 1) at one or both of the subsequent assessments. The remainder (275 patients) retained their low DD scores at the two subsequent study waves (−DD). All subsequent analyses included these 332 patients. Univariate results showed more females, younger patients, less educated patients, those with higher stress and previous MDD, and patients with higher BMI in the +DD than −DD groups over time. No consideration was given to when high DD occurred in the +DD group because this was a non-interventional study and we were interested only in the emergence of high DD any time over an 18-month period.

Predictors of +DD

The logistic regression models for each of the three blocks of variables are presented in Table 2. No multicolinearity was detected in any model. In the general patient characteristics model, significant ORs ($p < 0.05$) occurred for age, education, sex, and chronic stress, with three other ORs approaching significance: ethnicity, previous MDD and NLE. Controlling for the other characteristics, the odds of becoming distressed over time were higher among younger patients, those with less education, women, Caucasians, those with previous MDD, and those experiencing NLE and/or chronic stress.

In the biological model, with patient characteristics included, only number of complications reached significance: the odds of becoming distressed increased with each additional diabetes complication.

In the behavioural model, with patient characteristics included, EXERCISE and DIET reached significance. Those with less physical activity and those eating less well were more likely to become high DD over time.

Table 2 also shows the trimmed model that included only the significant variables found in the initial three analyses. Of the 10 variables that approached or reached statistical significance in the general, biological and behavioural analyses, 8 continued to reach or approach significance in the combined analysis, and the ORs remained similar across models. Not shown are the results of an analysis that included all predictors from the initial three blocks of variables: again, all ORs remained stable and maintained their significance. Combining the results from all analyses, the odds of reaching +DD during the 18 months following initial assessment were most consistently associated with: being female, having MDD during the previous year, experiencing more NLE and more chronic stress, having high numbers of complications, and having poor diet and low exercise. For each model, the ROC statistics indicated adequate fit and excellent discrimination (e.g., trimmed model AUC=.82).

Exploratory Analyses of Interactions

Nine interaction terms with NLE, chronic stress and previous MDD reached or approached significance in step two of the analysis of each of the three blocks of variables predicting +DD. Of these, five maintained significance after all subsequent analyses were completed: sex by NLE ($p < 0.02$), MDD by NLE ($p < 0.01$), HbA_{1c} by NLE ($p < 0.01$), complications by NLE ($p < 0.01$), and time since diagnosis by MDD ($p < 0.02$). For the HbA_{1c} and complications terms, higher NLE enhanced the relationship between each variable and the emergence of +DD. That is, as more NLEs occurred, the odds of +DD increased for those with high HbA_{1c} and for those with more complications. Furthermore, the effects of NLE on +DD were greater in men than women and in those without than with recent MDD. Finally, previous MDD qualified the relationship between time since diagnosis and the emergence of

+DD over time. Among those with no MDD, those who had diabetes longer were less likely to reach criteria for +DD; among those with a recent episode of MDD, those with diabetes longer were somewhat more likely to reach criteria for +DD.

DISCUSSION

We reported previously that the point prevalence of high DD was about 18% of patients in our diverse community sample, and that high DD, once it occurs, is a relatively persistent condition (3). In the current study we found that an additional 17.2% of patients without high DD at initial assessment reported high DD during the following 18 months. We identified a core group of variables that, across analyses, were consistently predictive of +DD, with ROC statistics indicating good discriminability between groups: being female, having MDD during the previous year, experiencing more NLE and more chronic stress, having high numbers of complications, and having poor diet and low exercise.

Of interest is that, even with the relatively small sample size (N=332), the ORs for general patient characteristics, biological variables and behavioural variables remain stable across all analyses. This, along with a lack of multicollinearity, suggests that their associations with +DD are relatively independent of the other variables that are included. Also of note, both NLE and chronic stress reached or approached statistical significance in all three models and across all analyses: in each case, high NLE and more chronic stress, unrelated to diabetes or its management, are associated with subsequent +DD. It appears that the stresses associated with having significant complications, the demands of NLE and non disease-related chronic stress, the difficulties of effectively managing diet and exercise, and the burdens posed by a recent episode of MDD each contribute independently to +DD.

Similar patterns emerge upon review of the exploratory analyses of interactions, such that both non diabetes-related stressors (NLE) and diabetes-related stressors (HbA_{1c}, complications) magnify the effect of other conditions on +DD. For example, NLE increases the negative effects of both higher HbA_{1c} and higher complications on +DD, such that NLE has a greater negative effect for patients who experience a more severe disorder. Likewise, even though male patients and those without recent MDD have a somewhat lower probability of +DD over time than female patients and those with MDD, high NLE appears to neutralize these differences. Under conditions of high NLE, the probabilities of becoming distressed increase significantly among male patients and those without MDD. In this sense, stressors from both diabetes-related and non health-related areas of life contribute to predicting +DD.

These findings suggest that not only do broader life context issues influence diabetes and its management directly, they may also interact with diabetes-specific factors, such as HbA_{1c} and complications, to affect +DD. Although many clinicians have become increasingly aware of the influence of diabetes-related distress and depressive affect on self-management and diabetes outcomes 11, less attention has been devoted to other equally powerful stressors that occur within the patient's broader life context that can also affect diabetes. For example, in a large primary care sample, Albright, et al. 7 showed that personal stress and family context, among others, are significantly associated with diabetes self-care activities; and several daily assessment studies have indicated that patient reports of stressful days, unrelated to diabetes management, are linked to subsequent changes in average blood glucose levels 5, 14. Thus, current levels of financial, work, family and other event-based and chronic life stressors should be assessed and responded to when designing programs of care. For example, a period of significant chronic or NLE stress may not be the best time to introduce major changes in physical activity, diet, or introduction of insulin therapy. Furthermore, it may be important to refer patients to services that might help reduce the

impact of these stressors before they affect diabetes management. The list of predictors of +DD above provide rough areas for screening those patients with current low DD who are at risk for high DD in the near future, with special emphasis on women, and those with high NLE. NLE may be especially important in this regard because of its potential for magnifying the impact of diabetes characteristics, such as HbA_{1c} or complications on subsequent distress.

There are several limitations to these findings. First, we systematically explored a relatively large number of predictors with a sample of modest size. Although we evaluated potential problems by assessing the ORs at the univariate level, employed a step-wise procedure, re-evaluated with backward elimination, and tested for multicollinearity to assess for instability of results, our findings, especially the interaction term data, will require replication. Second, we did not explore the potentially protective effects of patient traits and social supports that could serve to buffer the effects of stress on +DD. Third, we explored only a relatively narrow range of potential predictors. Other, unevaluated patient characteristics may be equally predictive.

Despite these limitations, the current study shows that, over and above those who are already distressed about diabetes at any one point in time (~19%), an additional 17% of type 2 diabetic patients become high DD over the succeeding 18 months. We identified several significant, independent predictors of subsequent high DD that can be used for patient screening to identify this high risk patient cohort. Given the impact of high DD on diabetes behavioural and biological indicators, the findings suggest the usefulness of regularly appraising both current life and disease-related stressors in clinical care.

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Table 1

Characteristics of the whole cohort, those who did not have diabetes distress at any point during the study and those who developed diabetes distress during the study

	All Cases (N=332)	− DD (N=275)	+ DD (N=57) Mean±SD
Age (years)	58.1±9.87	59.0±9.38	53.4±10.88‡
Education (years)	14.7±3.33	14.9±3.28	13.7±3.43*
Male n (%)	154 (46.4)	140 (50.9)	14 (24.6)‡
White ethnicity n (%)	132 (39.8)	109 (39.6)	23 (40.4)
Time since diagnosis (years)	7.5±6.73	7.6±6.88	6.9±5.94
Previous MDD	0.10±0.30	0.07±0.26	0.22±0.42‡
No. of negative life events	3.3±2.75	3.0±2.53	4.6±3.36‡
No. of chronic stressors	4.9±3.65	4.4±3.51	6.8±3.70‡
HbA_{1c} (%)	7.2±1.44	7.2±1.44	7.3±1.42
No. of comorbidities	3.7±2.40	3.6±2.30	4.1±2.81
No. of diabetes complications	0.7±1.11	0.6±1.05	1.1±1.30†
BMI (kg/m^2)	32.2±7.33	31.8±7.41	34.1±6.66*
Diastolic blood pressure (mmHg)	80±10	80±10	81±11
Systolic blood pressure (mmHg)	131±17	131±18	130±15
Non HDL cholesterol (mmo/l)	3.4±1.20	3.5±1.16	3.8±1.39
Diet adherence (days in last week)	4.4±1.45	4.5±1.42	4.0±1.53*
Exercise adherence (days in last week)	3.4±2.35	3.6±2.35	2.4±2.15‡

*p<.05;

†p<.01;

‡p<.001

Mean±SD or n (%)

−DD = group of patients with low diabetes distress at all 3 time points.

+DD= group of patients with low diabetes distress at initial assessment who display high diabetes distress 9 or 18 months later.

Table 2

Logistic Regression Models Predicting +DD (N = 332)

	General Patient Characteristics		Biological Variables		Behavioural Variables		Trimmed Model	
	OR	**(95%CI)**	**OR**	**(95%CI)**	**OR**	**(95%CI)**	**OR**	**(95%CI)**
Age	0.96*	(0.93 – 0.99)	0.95*	(0.91 – 0.99)	0.97	(0.93 – 1.00)	0.97	(0.93 – 1.01)
Education (years)	0.88*	(0.80 –0.98)	0.91	(0.82 – 1.01)	0.89†	(0.80 –0.99)	0.92	(0.82 – 1.02)
Sex (1/0 = F/M)	3.74†	(1.77– 7.90)	3.65‡	(1.66 – 8.00)	3.69‡	(1.71 – 7.97)	3.87‡	(1.77 – 8.44)
Ethnicity (1/0=white/non–white)	1.83	(0.86 – 3.89)	1.97	(0.89 – 4.36)	1.71	(0.79 – 3.71)	1.85	(0.83 – 4.11)
Time since diagnosis (years)	1.00	(0.95 – 1.06)	0.98	(0.92 – 1.04)	0.99	(0.94 – 1.05)	0.98	(0.92 – 1.04)
Past year MDD (1/0 = y/n)	2.20	(0.87 – 5.59)	2.29	(0.87 – 6.06)	2.52*	(0.99 –6.42)	2.74*	(1.05 –7.14)
Negative life events	1.12	(0.99 – 1.26)	1.10	(0.98 – 1.25)	1.15*	(1.02 –1.30)	1.14*	(1.01 –1.30)
Chronic stress	1.12*	(1.02 –1.22)	1.12*	(1.01 –1.23)	1.11*	(1.01 –1.22)	1.13*	(1.02 –1.24)
HbA_{1c}			1.04	(0.81 – 1.33)				
BMI			1.01	(0.97 – 1.06)				
No. of comorbidities			1.04	(0.90 – 1.20)				
No. of complications			1.41*	(1.06 –1.87)			1.52†	(1.13 –2.03)
Diastolic blood pressure			0.99	(0.94 – 1.03)				
Systolic blood pressure			1.01	(0.99 – 1.04)				
Non HDL cholesterol			1.00	(1.00 – 1.01)				
Diet					0.82*	(0.65 –0.99)	0.77*	(0.61 –0.98)
Exercise					0.83†	(0.71 – 0.97)	0.82*	(0.70 –0.97)

CI = confidence interval

*p<0.05;

†p<0.01

‡p<0.001

+DD = group of patients with low diabetes distress at initial assessment who display high diabetes distress 9 or 18 months later.