Investigation of anxiety and depression symptom co-morbidity in a community sample with type 2 diabetes: Associations with indicators of self-care

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ABSTRACT

OBJECTIVES: Ascertain the association of elevated co-occurring anxiety and depression symptoms, elevated anxiety symptoms alone or elevated depression symptoms alone with indicators of self-care behaviours in people with type 2 diabetes.

METHODS: Data from a community sample of 1,990 people diagnosed with type 2 diabetes for less than 10 years were assessed. All participants took part in a telephone interview. Questionnaires examined depression, anxiety, health, and indicators of self-care (physical activity, blood glucose monitoring, diet and smoking). Data were assessed with cross tabulations, ANOVA and logistic regression.

RESULTS: Groups who met criteria for elevated co-occurring anxiety and depression symptoms, elevated anxiety symptoms and elevated depression symptoms were more likely to report poor eating habits. Meeting criteria for either elevated depression symptoms (with and without anxiety) was also associated with an increased likelihood of not meeting physical activity recommendations. Those people with elevated depression and anxiety scores were more likely to be a current smoker.

CONCLUSIONS: Those people who meet criteria for elevated anxiety and/or depression symptoms are less likely to report adhering to self-care recommendations. These associations are particularly marked in those people with elevated depression symptoms with or without co-occurring anxiety symptoms. There is a lot of evidence emphasising the importance of monitoring depressive symptoms in people with diabetes. Our results add to this, indicating that adherence to self-care recommendations should be carefully monitored in people with depression and anxiety symptoms.

KEY WORDS: Depression; anxiety; type 2 diabetes

La traduction du résumé se trouve à la fin de l'article.

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Type 2 diabetes mellitus is a non-communicable disease associated with difficulty maintaining optimal blood glucose levels and an increased likelihood of developing serious macro- and micro- vascular complications.[1] However, along with physical complications there is also evidence that people with diabetes have an increased likelihood of being diagnosed with psychological disorders, including depression[2] and anxiety.[3]

The impact of co-morbid psychological disorders in people with diabetes is an area of research that is attracting increasing attention from both national and international diabetes organizations, with particular attention being paid to the impact of depression. In people with diabetes, depression has consistently been shown to be associated with decreased adherence to the self-care regimen,[4] an increased likelihood of developing serious complications,[5] poorer functioning[6] and an increased risk of mortality.[7,8]

However, depression is rarely a standalone psychological disorder and it is frequently co-morbid with other psychological disorders, in particular anxiety disorders.[9] Furthermore, recent research shows that people with diabetes are more likely to be diagnosed with co-morbid depression and anxiety than people who do not have diabetes.[10] It may be important to consider the role of co-occurring depression and anxiety in people with diabetes as anxiety is associated with many similar adverse outcomes to depression. In people with diabetes, anxiety is associated with increased symptom burden,[11] increased physical complications,[12] decreased physical activity[13,14] and an increased likelihood of being a current smoker.[12]

Despite the frequent co-morbidity between depression symptoms and anxiety symptoms, there is a lack of research investigating the association of this co-morbidity with self-care in people with diabetes. By better characterizing the associations of elevated depression symptoms alone, elevated anxiety symptoms alone or co-occurring elevated depression and anxiety symptoms with indicators of self-care and health, it may be possible to better understand the relationship between anxiety and depression, and self-care and health. Better characterization

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of which psychological factors are associated with important clinical outcomes would have implications for better targeted psychological screening within clinical practice.

The first objective of this study was to describe the prevalence of elevated anxiety symptoms, elevated depression symptoms and co-occurring elevated anxiety and depression symptoms. The second objective was to characterize the associations of elevated co-occurring anxiety and depression symptoms, elevated anxiety symptoms or elevated depression symptoms with indicators of self-care behaviours in a community-based sample diagnosed with diabetes for 10 years or less.

METHODS

Sampling and participants

Data for this analysis were taken from the 2011 baseline portion of the Evaluation of Diabetes Treatment (EDIT) study. The EDIT study is a longitudinal community-based study of Quebec residents with type 2 diabetes (2011–2014). Inclusion criteria included being aged 40–75, diagnosed with diabetes for less than 10 years (as determined by self-reported doctor diagnosis) and insulin-naïve. Participants were sampled using random digit-dialing and letters of invitation (for more information, see ref.15). A total of 196,605 people were contacted, with 3,789 confirming they met inclusion criteria. Of those participants who were eligible, a total of 2,028 completed a telephone survey that consisted of questions about physical health, lifestyle and psychological status (for characteristics of the sample, see Table 1).

Table 1. Baseline characteristics of EDIT sample (n = 2028)

		Frequency	Percentage
Age	60.51 ± 8.4		
Sex	Female	1014	50.2
Male	Male	1007	49.8
Marital status	Married/partner	1320	65.3
	Widowed/ divorced/ separated	463	22.9
	Never married	239	11.8
Employment status	Working full/ part time	788	39.0
	Not working	302	14.9
	Retired	933	46.1
Education	Less than high school	814	40.7
	High school graduation	617	30.9
	Post high school	568	28.4
Household income	<$15,000	280	15.9
	$15,000–$50,000	853	48.3
	>$50,000	633	35.8
Duration of diabetes (mean years ± SD since diagnosis)	4.59 ± 3.1		
Treatment	Oral medication	1825	90.0
	Lifestyle	203	10.0
Diabetes complications	None	718	37.6
	One complication	603	31.6
	Two or more complications	588	30.8
Chronic conditions	None	374	19.1
	One condition	584	29.9
	Two or more conditions	997	51.0
BMI	Underweight	9	0.5
	Normal	327	17.0
	Overweight	738	38.3
	Obese	853	44.3

EDIT = Evaluation of Diabetes Treatment.

The study protocol and sampling procedures gained full ethical approval from the Ethics Board of the Douglas Hospital Research Centre.

For this analysis, data for underweight individuals were excluded, due to the low number of people in this category. Only those participants who had completed both anxiety and depression questionnaires were included, leaving a total of 1,990 participants.

Questionnaires

Anxiety and Depression Assessment

Presence of elevated depression symptoms was ascertained using the 9-item Patient Health Questionnaire (PHQ-9),[16] a validated scale that uses diagnostic items to assess for the presence of moderate to severe depression as indicated by a score of ≥10.[17]

Presence of elevated anxiety symptoms was assessed using the 7-item Generalized Anxiety Disorder questionnaire (GAD-7).[18] The GAD-7 screens for general items of current anxiety, with presence of moderate to severe anxiety indicated by a score of ≥10.[18]

Participants were then placed into one of four categories based on whether they met the cut-off for clinically significant anxiety and/or depression symptoms:

Below threshold anxiety and depression symptoms: Score <10 for both GAD-7 and PHQ-9.
Elevated anxiety symptoms: Score ≥10 for GAD-7 and <10 for PHQ-9.
Elevated depression symptoms: Score ≥10 for PHQ-9 and <10 for GAD-7.
Co-occurring elevated anxiety and depression symptoms: Score ≥10 for GAD-7 and PHQ-9.

Self-care Indicators

All indicators of self-care behaviours were dichotomized based on current Canadian recommendations for self-care.[19]

Blood glucose checking was assessed by asking how often participants checked their blood glucose. Categories were formed based on current Canadian recommendations for people taking oral medication.[20] Testing as recommended was testing one or more times per day to once per week. Testing less than recommended was checking less than once per week.

Eating habits were assessed by asking participants how they would rate their past-month eating habits (excellent/very good/good/fair/poor) and then dichotomized in line with previous work.[21] Those who answered that their eating habits were excellent, very good or good were assessed as having good eating habits; those who answered "fair" or "poor" were assessed as having poor eating habits.

Physical activity was assessed with a single-item question asking how many days in the previous month participants had engaged in at least 15 minutes of moderate to strenuous exercise or activities. People were categorized as meeting recommendations if they reported engaging in a minimum of 12 sessions of

exercise over the last month, and not meeting physical activity recommendations if they reported participating in less than 12 sessions in the last month. This categorization was based on CDA recommendations for participating in physical activity for at least 3 days per week.[19]

Smoking status was assessed by asking whether participants currently smoked. Those people who reported being former or never smokers were classified as meeting smoking recommendations. Those people who reported being current smokers were classified as not meeting recommendations.

Confounders

Diabetes complications were assessed using the validated 17-item diabetes complications index (DCI[22]). The DCI screens for presence of the following diabetes complications: coronary artery disease, cerebrovascular disease, peripheral vascular disease, neuropathy, retinopathy, foot problems.

BMI (BMI; kg/m^2) was calculated based on self-reported weight and height.

Socio-demographic factors assessed in this study were based on those asked in the Canadian Community Health Surveys[23] and based on self-report. Categorization of these factors was based on that used in previous studies.[15,21] Variables included in the main analysis were age, sex (male/female) marital status (married/partner; widowed/divorced/separated; never married), employment status (working full or part-time/retired/not working) and education (less than high school/high school graduation/post high school).

Data analysis

Categorical descriptive data were assessed using cross tabulations. Continuous descriptive data were assessed using one-way analysis of variance (ANOVA), with Bonferonni-corrected post-hoc comparisons.

Logistic regression analyses were used to assess non-adherence to recommendations for each indicator of self-care and each health outcome with presence of elevated depression symptoms, elevated anxiety symptoms or co-occurring elevated anxiety and depression symptoms. Analyses were first plotted as unadjusted associations. They were then adjusted for socio-demographic factors and other relevant confounders (see footnotes for Table 3).

RESULTS

Descriptive analyses

Of the total population studied, 85.3% (n = 1,698) had below-threshold anxiety and depression symptoms; 2.4% (n = 48) had above-threshold anxiety symptoms; 5.6% (n = 111) had above-threshold depression symptoms and 6.7% (n = 133) had above-threshold anxiety and depression symptoms. Overall, 9.1% of our sample met criteria for elevated anxiety symptoms and 12.3% for elevated depression symptoms. When all four groups

Table 2. Comparison between groups: Descriptive data

			N	Below threshold A/D symptoms % (*N* = 1698)	Elevated A symptoms % (*N* = 48)	Elevated D symptoms % (*N* = 111)	Co-occurring elevated A/D symptoms % (*N* = 133)
Health behaviours	Checking blood glucose	As recommended (daily-weekly)	1539	79.3	76.6	75.2	80.3
		Less than recommended (less than once per week)	408	20.7	23.4	24.8	19.7
	Smoking status**	Former smoker/never smoker	1572	81.2	83.3	68.5	62.1
		Current smoker	411	18.8	16.7	31.5	37.9
	Physical activity***	As recommended (≥12 days per month)	833	45.0	37.8	25.7	26.7
		Less than recommended (<12 days)	1126	55.0	62.2	74.3	73.3
	Eating habits***	Excellent/very good/good	1549	81.6	62.5	58.6	54.5
		Fair/poor	436	18.4	37.5	41.4	45.5
Confounders	BMI**	Normal	321	17.8	20.0	13.1	8.7
		Overweight	727	39.2	42.2	25.2	38.1
		Obese	846	43.1	37.8	61.7	53.2
	Diabetes Complications Index***	No complications	712	41.3	27.3	16.3	15.1
		1 complication	595	31.6	38.6	31.7	30.3
		2 or more complications	570	27.1	34.1	51.9	54.6
	Sex***	Female	994	47.1	75.0	64.9	65.9
		Male	992	52.9	25.0	35.1	34.1
	Marital status***	Married/partner	1299	67.6	64.6	47.7	53.8
		Widowed/divorced/separated	455	21.5	22.9	36.0	30.0
		Never married	230	10.9	12.5	16.2	16.2
	Work status***	Working full/part time	778	41.6	29.2	28.2	21.1
		Not working	292	11.8	16.7	27.3	40.6
		Retired	915	46.6	54.2	44.5	38.3
	Education**	Less than high school	800	39.7	37.0	39.4	56.8
		High school graduation	608	31.2	41.3	33.0	22.0
		Post high school	556	29.1	21.7	27.5	21.2
	Age (years ± SD)			60.58 ± 8.4	61.42 ± 8.1	60.06 ± 8.1	59.21 ± 8.6
Summary scores	GAD-7 (mean anxiety score ± SD)***			1.51 ± 2.3	12.47 ± 2.2	5.22 ± 2.5	14.58 ± 3.3
	PHQ-9 (mean depression score ± SD)***			2.51 ± 2.7	6.13 ± 2.3	12.36 ± 2.9	15.86 ± 4.3

A = anxiety; D = depression.

All categorical variables were compared using cross-tabulations. All continuous variables were compared using one-way ANOVA with Bonferonni-corrected comparisons. There was no significant difference between groups for age (F(3.1789) = 1.63, p = 0.2), but there was for depression severity (F(3.1789 = 1142.5, p < 0.001) and anxiety severity (F(3.1789 = 7630.2, p < 0.001).

* p < 0.05; ** p < 0.01; *** p < 0.001.

Table 3. Association of depression and/or anxiety symptoms with indicators of self-care

Self-care outcome			Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Checking blood glucose	Check less than once a week	Below-threshold A/D symptoms	1	1
		Elevated A symptoms	1.33 (0.64–2.75)	1.37 (0.66–2.86)
		Elevated D symptoms	1.04 (0.62–1.75)	1.10 (0.65–1.88)
		Co-occurring elevated A/D symptoms	0.92 (0.56–1.51)	0.98 (0.59–1.62)
Smoking status	Current smoker	Below-threshold A/D symptoms	1	1
		Elevated A symptoms	0.59 (0.23–1.53)	0.56 (0.21–1.46)
		Elevated D symptoms	1.82 (1.16–2.87)**	1.58 (0.98–2.53)
		Co-occurring elevated A/D symptoms	2.25 (1.50–3.39)***	1.90 (1.23–2.95)**
Physical activity	Active less than 3 times per week	Below-threshold A/D symptoms	1	1
		Elevated A symptoms	1.55 (0.80–2.99)	1.53 (0.78–2.98)
		Elevated D symptoms	2.22 (1.40–2.99)**	1.98 (1.23–3.17)**
		Co-occurring elevated A/D symptoms	2.18 (1.42–3.34)***	1.85 (1.19–2.87)**
Eating habits	Poor	Below-threshold A/D symptoms	1	1
		Elevated A symptoms	2.37 (1.23–4.59)**	2.71 (1.36–5.40)**
		Elevated D symptoms	3.35 (2.20–5.12)***	3.02 (1.94–4.71)***
		Co-occurring elevated A/D symptoms	4.19 (2.83–6.20)***	3.39 (2.23–5.14)***

A = anxiety; D = depression; OR = odds ratio; CI = confidence interval.
Reference categories for each outcome: checking blood glucose (check once a week or more); smoking status (former/never); physical activity (active 3 times or more per week); eating habits (excellent/very good/good).
Adjusted analysis: analyses adjusted for age, sex, marital status, employment status, education, BMI and diabetes complications.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

were compared for severity of anxiety and depression, there were significant differences between them (see Table 2). Bonferroni-corrected post-hoc comparisons revealed that those people with co-occurring elevated anxiety and depression had significantly higher anxiety and depression symptom scores when compared to all other groups. The group with both elevated depression and elevated anxiety symptoms had significantly higher mean depression and anxiety scores than the means observed in the groups with only one or the other of elevated anxiety or elevated depression symptoms.

All groups with elevated anxiety and/or depression symptoms were less likely to be adherent to physical activity recommendations and more likely to report poor eating habits (see Table 2). Both the groups with elevated depression symptoms and elevated co-occurring anxiety and depression symptoms were more likely to report being current smokers.

Furthermore, all groups with elevated anxiety and/or depression symptoms were more likely to report having one or more diabetes complications. The group with elevated depression and co-occurring anxiety symptoms were also more likely to report being overweight/obese (see Table 2).

Analysis of demographic and socio-economic confounders revealed that all groups with elevated anxiety and/or depression were more likely to consist of females. Comparison based on marital status showed that the two groups with elevated depression symptoms were less likely to be married. The group with elevated anxiety were more likely to be retired, and the groups with elevated anxiety and/or depression were all more likely to report not working. The groups with co-occurring depressive and anxiety symptoms and elevated anxiety were less likely to have post high-school education. However, there was no difference between groups for age (see Table 2).

Logistic regression: Self-care indicators

Those people who had elevated anxiety symptoms were significantly more likely to report poor eating habits than people with no anxiety or depression. This association remained significant after controlling for all confounders (see Table 3).

Those people who had elevated depression symptoms were more likely to report being a current smoker, being less physically active than recommended and having poor eating habits. The association between smoking and depression symptoms was no longer significant after controlling for confounders. However, the associations between depression symptoms and respectively physical activity and eating habits remained significant (see Table 3).

The group with co-occurring anxiety and depression symptoms were more likely to report being a current smoker, being less active than recommended and having poor eating habits. All associations remained significant after controlling for all confounders (see Table 3).

DISCUSSION

Results from this study indicate that there is a high degree of co-morbidity between elevated anxiety and depressive symptoms in people with type 2 diabetes. These results also provide evidence that anxiety and depression symptoms both alone and in combination are associated with poorer self-reported self-care in people with diabetes. Previous research has established the negative impact of depression[4] and to a lesser extent anxiety[12] on self-care behaviours. However, to our knowledge no study has explicitly examined the association of anxiety and depression symptoms, both alone and in combination, with self-care outcomes in people with diabetes.

Previous work has established that people with diabetes are more likely to be diagnosed with co-morbid anxiety and depression.[10] Work from this study indicates that the overall prevalence of elevated anxiety and depression are higher than population norms.[9,24]

The results from this study indicate that elevated depression symptoms (both with and without co-occurring anxiety symptoms) are associated with reporting problems with different aspects of the self-care regimen. However, elevated anxiety symptoms are significantly associated with reporting poor eating habits only (though point estimates for checking blood glucose and physical activity also indicate that elevated anxiety symptoms may have an impact on these outcomes).

It is possible that the more pronounced association of elevated depression symptoms with adherence to self-care indicators could be due to an overlap in depression symptoms and factors associated with self-care. For example, some of the core features of depression which people in the elevated depression symptoms groups could have endorsed include changes in appetite, concentration problems and increased fatigue. These depression symptoms would impact directly on meeting physical activity recommendations, remembering to take medication and following diet recommendations.

Results from this study indicate that those people who meet criteria for elevated anxiety and depression symptoms have a more statistically severe anxiety and depression than those people who have elevated anxiety symptoms or elevated depression symptoms alone. This could partially explain why the associations for reporting poor eating habits and smoking are most pronounced in the group with co-occurring elevated anxiety and depression symptoms (i.e., more severe depressive symptoms). However, this difference is not necessarily clinically important as all participants met criteria for moderate to severe depression and/or anxiety symptoms.[17,18] Furthermore, the low number of people in the elevated anxiety symptoms group possibly means that there was not sufficient power to detect significant associations between anxiety and self-care and health outcomes, despite point estimates that lay above 1.

Strengths and limitations

These results are limited by the use of self-report data and the possible impact of mood on perceptions of adherence to outcomes such as self-rated eating habits. As such, there are no objective clinical markers of self-care such as HbA1c or clinical tests of complications. There are also additional self-care indicators that were not explored in this study that are likely impacted by mental health, such as medication adherence and foot checking. The results are also limited by the use of anxiety and depression screening scales rather than diagnostic interviews. However, it could be argued that as these types of screening scales are the most likely to be used in diabetes clinical practice rather than the more lengthy diagnostic interviews, it is important to use these scales. However, no inferences on the effect of clinically diagnosable psychological co-morbidity can be made using this dataset. Despite these limitations, the results from this study do point to a potentially important association of anxiety and depression co-morbidity on diabetes self-care, which can be explored in future studies through clinical diagnoses of anxiety and depression alongside objective clinical parameters such as HbA1c. A further limitation is that the use of a cross-sectional dataset limits inferences on causality. It is possible that elevated depression and anxiety symptoms may lead to worsened self-care, or that worsened self-care may lead to increasing feelings of depression and anxiety. In the absence of longitudinal data, it is difficult to infer how these variables are related temporally. Future studies can explore the directional relationship of depression/anxiety and self-care and the role of factors such as diabetes complications and socio-economic status in this relationship. Another limitation is the fact that income was not included in the logistic regression analysis due to the high number of missing values. It is likely that income would be an important confounder in the relationships examined, however inclusion of this confounder would have led to a reduction in statistical power. Finally, the low number of people in the elevated anxiety symptoms group makes generalizability from this group difficult. However, this study and its interpretation are strengthened by the use of a large, homogenous and community-based representative sample.

Public health implications

There is a large body of evidence showing the negative association of depressive symptoms with adherence to self-care recommendations in people with diabetes.[4] However, there are few studies that have considered the impact of co-morbid anxiety in this relationship. Results from our study indicate that both depressive and anxiety symptoms are important factors that are associated with self-care in people with diabetes. This emphasizes the importance of monitoring self-care behaviours in people with both depressive and anxiety symptoms.

CONCLUSIONS

In conclusion, results from this study provide preliminary evidence that elevated depression symptoms both with and without co-occurring elevated anxiety symptoms are important clinical co-morbidities in people with diabetes. Furthermore, this study has important public health implications indicating that screening for anxiety and depression symptom co-morbidity is important within this population.

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RÉSUMÉ

OBJECTIFS : Établir avec précision l'association entre les symptômes élevés d'anxiété et de dépression concomitantes, les symptômes élevés d'anxiété seule ou les symptômes élevés de dépression seule et les indicateurs d'autosoins chez les personnes atteintes du diabète de type 2.

MÉTHODE : Nous avons analysé les données d'un échantillon communautaire de 1 990 personnes ayant un diagnostic de diabète de type 2 depuis moins de 10 ans. Les participants se sont prêtés à un entretien téléphonique. Les questionnaires ont porté sur la dépression, l'anxiété, la santé et les indicateurs d'autosoins (activité physique, surveillance de la glycémie, régime et tabagisme). Les données ont été évaluées à l'aide de tabulations en croix, d'analyses de la variance et d'analyses de régression logistique.

RÉSULTATS : Les groupes qui répondaient aux critères des symptômes élevés d'anxiété et de dépression concomitantes, des symptômes élevés d'anxiété et des symptômes élevés de dépression étaient plus susceptibles de déclarer avoir de mauvaises habitudes alimentaires. Le fait de répondre aux critères des symptômes élevés de dépression (avec et sans anxiété) était également associé à la probabilité accrue de ne pas respecter les recommandations d'activité physique. Les sujets dont les scores de dépression et d'anxiété étaient élevés étaient plus susceptibles d'être des fumeurs actuels.

CONCLUSIONS : Les personnes qui répondent aux critères des symptômes élevés d'anxiété et/ou de dépression sont moins susceptibles de déclarer qu'elles se conforment aux recommandations d'autosoins. Ces associations sont particulièrement prononcées chez les sujets ayant des symptômes élevés de dépression, avec ou sans symptômes d'anxiété concomitante. De nombreuses données probantes soulignent l'importance de contrôler les symptômes dépressifs chez les diabétiques. Nos résultats vont dans le même sens : la conformité aux recommandations d'autosoins devrait être soigneusement surveillée chez les personnes présentant des symptômes de dépression et d'anxiété.

MOTS CLÉS : dépression; anxiété; diabète de type 2