

Depression, anxiety, and associated factors in patients with diabetes: evidence from the Anxiety, Depression, and Personality Traits in Diabetes Mellitus (ADAPT-DM) study

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Abstract

Background Depression and anxiety are common psychiatric complications affecting patients with diabetes mellitus. However, data on the prevalence of depression, anxiety, and associated factors among Malaysian diabetic patients is scarce. The Anxiety, Depression, and Personality Traits in Diabetes Mellitus (ADAPT-DM) study aimed to determine the prevalence of depression and anxiety, and their associated factors in the Malaysian diabetic population.

Methods This cross-sectional study recruited 300 diabetic patients via convenience sampling from the Endocrine outpatient clinic of Universiti Kebangsaan Malaysia Medical Centre, a tertiary referral healthcare facility in Kuala Lumpur. Socio-demographic characteristics and clinical history were obtained from each participant. The Generalised Anxiety Disorder-7 (GAD-7) was administered to assess anxiety symptoms, the Beck Depression Inventory (BDI) to assess depressive symptoms, the Big Five Inventory (BFI) to evaluate personality traits, and the World Health Organization Quality of Life-BREF (WHOQOL-BREF) to measure quality of life (QOL). Multivariate logistic regression analyses were performed to determine the association between various factors, and depression and anxiety.

Results The prevalence of depression was 20% (n = 60) while anxiety was 9% (n = 27). Co-morbid depression (adjusted OR = 24.91, 95% CI = 5.67–109.42, p < 0.001), neuroticism (adjusted OR = 9.24, 95% CI = 2.03–42.03, p = 0.004), and greater physical health-related QOL (adjusted OR = 1.67, 95% CI = 1.07–2.59, p = 0.024) increased the odds of developing anxiety, while psychological QOL (adjusted OR = 0.41, 95% CI = 0.21–0.79, p = 0.008) was protective. Co-morbid anxiety (adjusted OR = 20.06, 95% CI = 4.70–85.57, p < 0.001) increased the odds of depression, while older age (adjusted OR = 0.96, 95% CI = 0.92–0.99, p = 0.012), regular religious practice (adjusted OR = 0.08, 95% CI = 0.01–0.56, p = 0.011) and physical health-related QOL (adjusted OR = 0.72, 95% CI = 0.59–0.89, p = 0.002) were protective.

Conclusions The study findings signify the need to screen for co-morbid depression and anxiety, as well as personality traits and QOL, and to include psychosocial interventions when planning a multidisciplinary approach to managing diabetes.

Background

Diabetes mellitus is a heterogeneous disorder that can result in severe morbidity with substantial emotional impact. The International Diabetes Federation (IDF) has estimated that approximately 425 million adults between the age of 2–79 years were afflicted with diabetes in 2017, and this number is projected to increase up to 629 million by 2045 [1]. Although diabetes is an international health crisis, its prevalence is increasing more rapidly in lower- and middle-income countries [2].

In recent decades, research has focused on the mental health comorbidities associated with diabetes. The occurrence of anxiety and depressive disorders can be as high as two-fold greater in individuals suffering from diabetes. These mood disorders are linked to suboptimal diabetic self-care, unhealthy behaviours, elevated HbA1c, and other sub-optimal metabolic indicators [3–7].

Evidence suggests a bidirectional relationship between diabetes mellitus, and anxiety and depressive disorders. Patients with anxiety symptoms may be at increased risk of developing type 2 diabetes and vice versa [7]. Various factors may contribute to the development of anxiety disorders among patients with diabetes, including personal and family history, stressful life events, substance use, and physical illness [7]. It is possible that diabetes and depression stem from similar or shared aetiologies, or the existence of one condition may increase the prevalence of the other [8]. Possible risk factors that may contribute to the development of depression in diabetic patients are personal and family history, stressful life events, domestic violence, physical illnesses, and clinical factors [8–11].

The relationship between diabetes and psychiatric disorders is still not fully understood.

Personality traits and quality of life (QOL) may contribute to the development and severity of psychiatric disorders in patients with diabetes, but this has not been comprehensively studied. Furthermore, data on the prevalence of depression and anxiety among Malaysian diabetic patients are scarce. In fact, much of the research on diabetes as it relates to personality and mood disorders has been conducted in higher-income countries, despite the strong need to understand these relationships in lower- and middle-income countries where individuals may face additional barriers to care [12]. Hence, the Anxiety, Depression, and Personality Traits in Diabetes Mellitus (ADAPT-DM) study was conducted to examine the prevalence of depression and anxiety among Malaysian diabetic patients, and to investigate their associated socio-demographic characteristics, personality traits, and QOL.

Methods

Study design and participants

The ADAPT-DM study used a cross-sectional design and participants were recruited over a period of two months at the Endocrine outpatient clinic of Universiti Kebangsaan Malaysia Medical Centre (UKMMC), a tertiary referral centre in Kuala Lumpur, Malaysia. Approval was obtained from the Human Ethics Committee of the Faculty of Medicine, Universiti Kebangsaan Malaysia (UKM FPR.SPI 800-2/28/166/FF-2019-342). Sample size was calculated based on previous estimates of the prevalence of depression and generalized anxiety disorder in patients with diabetes, which are 20% and 14% respectively [13, 14]. The sample size required was 234 subjects. Study participants were recruited via convenience sampling, in which those who attended the Endocrine clinic as outpatients and interested in

participating were provided with detailed explanations of the study by the researchers. Then, they were screened for inclusion criteria, such as (1) being 18 years and above and (2) having a confirmed diagnosis of type 1, type 2, or gestational diabetes mellitus. Patients with impaired mental capacity, such as those with psychotic features or cognitive impairment, were excluded from the study. The eligible participants were allowed to participate in the study if verbal and written informed consent was given. All participants who were found to have depression and anxiety disorders were referred to Department of Psychiatry, UKMMC for further assessment.

Measuring tools

The participants completed a questionnaire which collected data on demographic, social, and clinical characteristics. The demographic variables included age, gender, marital status, ethnicity, education level, employment status, household income, and religion. The social variables included perceived level of social support, smoking, alcohol use, and recreational drug use. Clinical variables included medical history, diabetes history (onset, type, and use of insulin therapy), body mass index (BMI), and self-perceived management of diabetes (assessed using a five-point Likert scale). Information provided from the questionnaire was supplemented by a review of patient medical records where applicable. In addition, the participants were administered the seven-item Generalised Anxiety Disorder scale (GAD-7) to assess the prevalence of anxiety, Beck Depression Inventory-II (BDI-II) to assess the prevalence of depression, Big Five Inventory (BFI) to assess personality traits, and the World Health Organization Quality of Life-BREF (WHOQOL-BREF) to measure quality of life (QOL).

Seven-item Generalised Anxiety Disorder scale (GAD-7):

The GAD-7 is a self-reported questionnaire designed to screen for generalized anxiety disorder (GAD). It consists of seven items, with each item being assessed using a Likert scale of 0 to 3. Hence, its total score ranges from 0 to 21. The GAD-7 has been found to be a good case-finding instrument for GAD. Participants with scores ≥ 8 are classified as having GAD. The GAD-7 has proven to be reliable, with a sensitivity of 92% and specificity of 76% at cut-off point of ≥ 8 [15]. The Malay version of the GAD-7 used in this study has been proven to be reliable, with a sensitivity of 76% and specificity of 94% [16].

Beck Depression Inventory-II (BDI-II):

The BDI-II is a self-reported questionnaire commonly used to screen for and assess the severity of depression. It is comprised of items that are related to depressive symptoms. It is made up of 21 items, each scored from 0 to 3. A score of 10 to 16 indicates mild depression, a score of 17 to 29 indicates moderate depression, and a score between 30 and 63 indicates severe depression [17]. The BDI-II has been proven to have good internal consistency, with Cronbach's α of 0.91. The Malay version of the BDI-II has also been deemed to have good internal consistency (Cronbach's $\alpha = 0.71$ to 0.91) and excellent psychometric properties [18].

Big Five Inventory (BFI):

The BFI is a short instrument that assesses personality traits based on the Five Factor model. The BFI includes 44 items divided into five subscales: extraversion, agreeableness, conscientiousness, neuroticism, and openness. Each item is scored on a five-point Likert

scale ranging from 0 (strongly agree) to 4 (strongly disagree) [19]. The Malay version of the BFI has been proven to have good internal consistency, as well as good convergent and discriminant validity [20].

World Health Organization Quality of Life-BREF (WHOQOL-BREF):

The WHOQOL-BREF is a self-reported questionnaire that assesses quality of life. It is comprised of 26 items. Items 1 and 2 assess overall quality of life, while the remaining items are grouped into four categories that evaluate different domains: physical health, psychological, social relationships, and environmental quality of life. Each item is scored on a Likert scale ranging from 1 to 5. The WHOQOL-BREF has good psychometric properties and has been proven to be a valid and reliable alternative to the WHOQOL-100 for measuring quality of life [21]. The Malay version of the WHOQOL-BREF has also demonstrated excellent psychometric properties with internal consistency (Cronbach's α) of 0.89 [22].

Data analysis

Statistical analysis was carried out using the Statistical Package for Social Science (SPSS) (version 20.0; IBM, Armonk, NY). Descriptive statistics were computed in which categorical variables were reported in frequency and percentage, and continuous variables reported in median and interquartile range (IQR). The continuous variables were not normally distributed as demonstrated by the Kolmogorov-Smirnov test ($p < 0.05$). The missing data was resolved with mode imputation as the variables with missing data were all categorical variables. The associations between demographic, social, and clinical characteristics, and anxiety and depression were evaluated with Pearson's chi-square test or Fisher's exact test. The associations between BFI and the WHOQOL-BREF scores, and anxiety and depression were evaluated with Mann-Whitney U test. Variables with significant differences ($p < 0.05$) were then entered into multivariate logistic regression analysis to determine the factors which significantly predicted occurrence of anxiety and depression among participants. Statistical significance for all analyses was set to $p < 0.05$.

Results

Demographic, social, and clinical characteristics, personality traits, and quality of life

The demographic, social, and clinical characteristics of participants, as well as their personality traits and quality of life, are summarized in Table 1. A total of 300 participants were enrolled in the study. The median age of the participants was 63 years (IQR = 16 years). Approximately half of the participants were males ($n = 158, 52.7\%$). More than half of the participants were Malays ($n = 195, 65.0\%$) and a similar proportion of participants were Muslim ($n = 199, 66.3\%$). Large proportion of the participants also agreed that they had regular religious practice ($n = 237, 79.0\%$). The majority of participants were married ($n = 231, 77.0\%$), and an almost equal proportion of participants received up to a secondary level of education ($n = 133, 44.3\%$) or a tertiary level of education ($n = 119, 39.7\%$). A minority of participants were retired ($n = 123, 41\%$), and slightly more than half were earning less than RM 3000 per month ($n = 166, 55.3\%$). The majority of participants perceived that they had good social support, with 80.3% ($n = 241$) of participants 'agreeing' with adequate social support. The majority of participants had never smoked ($n = 216, 72.0\%$), had never consumed alcohol ($n = 271, 90.3\%$), and had no history of recreational drug use ($n = 294, 98\%$).

With regard to clinical characteristics, the majority of participants were diagnosed with type 2 diabetes mellitus (n = 269, 89.7%), while a minority had been diagnosed with type 1 diabetes mellitus (n = 22, 7.3%) or gestational diabetes mellitus (n = 6, 2.0%). The median duration of diabetes diagnosis was 14 years (IQR = 12 years), while the median HbA_{1c} measurement was 7.6% (IQR = 2.7%). Almost half of the participants were on insulin therapy (n = 138, 46.0%). More than half of the participants perceived that they managed their illness well; in fact, 71.3% (n = 214) of participants 'agreed' with the statement 'I am able to manage my diabetes well'. Almost half (49.0%, n = 147) of participants were overweight (BMI 25–30), while 26.0% (n = 78) were obese (BMI > 30).

Screening with the GAD-7 indicated that only a small proportion of the participants had anxiety (9%, n = 27), while BDI-II screening revealed that a relatively larger proportion of participants had depression (20%, n = 60). In BFI assessment, the median of extraversion was 3.38 (IQR = 0.75), agreeableness was 3.78 (IQR = 0.43), conscientiousness was 3.67 (IQR = 0.60), neuroticism was 2.50 (IQR = 0.73), and openness was 3.30 (IQR = 0.60). The WHOQOL-BREF screening revealed that the median of the physical health score was 14.29 (IQR = 3.43), the psychological score was 15.33 (IQR = 2.67), the social relationships score was 16.00 (IQR = 2.67), and the environment score was 15.00 (IQR = 2.50).

[Table 1 here]

The association between demographic, social, and clinical characteristics, personality traits and quality of life, and anxiety among participants

The findings of the Pearson's chi-square tests, Fisher's exact tests, and Mann-Whitney U tests examining associations between demographic, social, and clinical characteristics, personality traits, quality of life, and anxiety are summarized in Table 2. The only

demographic characteristic showing a significant difference between those with anxiety and those without anxiety was ethnicity: a significantly greater number of non-Malays presented with anxiety (p = 0.019). There were no significant differences in the history of cigarette smoking, alcohol intake, and recreational drug use between those with anxiety and without anxiety. On the contrary, there were several clinical characteristics, personality traits, and quality of life components which were significantly different between those with anxiety and without anxiety. Anxiety was significantly associated with self-perceived poor diabetic control (p = 0.003), depression (p < 0.001), poorer overall perception of quality life (p < 0.001), poorer overall perception of health (p = 0.006), lower extraversion scores (p = 0.031), lower agreeableness scores (p = 0.004), higher neuroticism scores (p < 0.001), poorer physical quality of life (p < 0.001), poorer psychological quality of life (p < 0.001), poorer social quality of life (p < 0.001), and poorer environmental quality of life (p < 0.001).

[Table 2 here]

The association between demographic, social, and clinical characteristics, personality traits and quality of life, and depression among participants

The findings of the Pearson's chi-square tests, Fisher's exact tests, and Mann-Whitney U tests examining the associations between demographic, social, and clinical characteristics, personality traits, quality of life, and depression among participants are summarized in Table 3. There were three demographic characteristics significantly different between participants screened positive for depression and participants screened negative for depression. A larger proportion of younger ($p = 0.032$) and employed ($p = 0.033$) participants presented with depression. While a smaller proportion of participants who reported to have regular religious practice presented with depression ($p = 0.001$). There were no significant differences in social characteristics between depressed and non-depressed participants. Several clinical characteristics, personality traits, and quality of life components showed significant differences between depressed and non-depressed participants. Depression was associated with poorer self-perceived diabetic control ($p < 0.001$), anxiety ($p < 0.001$), poorer overall perception of quality of life ($p < 0.001$), poorer overall perception of health ($p < 0.001$), lower extraversion scores ($p = 0.019$), lower agreeableness scores ($p = 0.013$), lower conscientiousness scores ($p = 0.003$), higher neuroticism scores ($p < 0.001$), poorer physical quality of life ($p < 0.001$), poorer psychological quality of life ($p < 0.001$), poorer social quality of life ($p < 0.001$), and poorer environmental quality of life ($p < 0.001$).

[Table 3 here]

Multivariate logistic regression analyses between various factors and anxiety among participants

The findings of multivariate logistic regression analyses between demographic characteristics (ethnicity), clinical factors (diabetic control and depression), personality traits (extraversion, agreeableness, and neuroticism), quality of life (overall perception, physical, psychological, social, and environmental QOL), and anxiety among participants are summarized in Table 4. There were only a few factors predictive of anxiety among participants. Respondents who were depressed (adjusted OR = 24.91, 95% CI = 5.67–109.42, $p < 0.001$) with higher neuroticism scores (adjusted OR = 9.24, 95% CI = 2.03–42.03, $p = 0.004$), and higher physical health scores on quality of life (adjusted OR = 1.67, 95% CI = 1.07–2.59, $p = 0.024$) had higher odds of having anxiety. On the contrary, anxiety was associated with higher psychological scores on the quality of life questionnaire (adjusted OR = 0.41, 95% CI = 0.21–0.79, $p = 0.008$). Ethnicity, other clinical factors, personality traits, and QOL components were not significant predictors of occurrence of anxiety among the participants.

[Table 4 here]

Multivariate logistic regression analyses between various factors and depression among participants

The findings of multivariate logistic regression analyses between demographic characteristics (age and employment status), clinical factors (diabetic control and anxiety), personality traits (extraversion, agreeableness, conscientiousness, and neuroticism), quality of life (overall perception, physical,

psychological, social, and environmental QOL), and depression among participants are summarized in Table 5. The only clinical factor associated with higher odds of depression was anxiety, which increased the occurrence of depression by 20-fold (adjusted OR = 20.06, 95% CI = 4.70–85.57, $p < 0.001$). On the contrary, older age (adjusted OR = 0.96, 95% CI = 0.92–0.99, $p = 0.012$), having regular religious practice (adjusted OR = 0.08, 95% CI = 0.01–0.56, $p = 0.011$), and higher physical health quality of life scores (adjusted OR = 0.72, 95% CI = 0.59–0.89, $p = 0.002$) were associated with lower odds of occurrence of depression. Employment status, and all other clinical factors, personality traits, and QOL components did not significantly predict depression among the participants.

[Table 5 here]

Discussion

The ADAPT-DM study aimed to determine the prevalence of depression and anxiety, and their associated factors among Malaysian patients with diabetes. Regarding the prevalence of depression and anxiety, we found that 9% of the participants screened positive for anxiety and 20% met criteria for depression. The prevalence of depression reported in our study was similar to that reported in previous studies, where prevalence was estimated between 18% and 30% [23]. The prevalence of anxiety among participants in our study was relatively low compared to the prevalence reported by the INTERPRET-DD study, which estimated the prevalence of anxiety (all anxiety disorder included) to be 18% based on data collected from 3170 diabetic patients from 15 countries in different continents [24]. This may be explained by the difference in instruments used for assessing anxiety. While we used the GAD-7, which is designed to assess for generalized anxiety disorder (GAD), the INTERPRET-DD study used the Mini International Neuropsychiatric Interview. The prevalence of GAD specifically reported by the INTERPRET-DD study was 8.1%, which was similar to the prevalence of anxiety disorder reported in our study [24].

Our findings reveal that depression, neuroticism, and higher physical health-related quality of life increased the odds of developing anxiety by almost 25-fold, 9-fold, and 1.6-fold, respectively. Better psychological QOL was protective against anxiety and reduced the occurrence of anxiety by half (0.4-fold). The occurrence of depression greatly increased the odds of anxiety in our study, which is similar to what was reported in a study of 893 Chinese patients with diabetes [25]. The positive correlation between depression and anxiety is well documented in chronic illness, and the occurrence of depression can increase the risk of anxiety symptoms in patients with chronic illness [26, 27]. This relationship is expected as some theories suggested that anxiety and depression shared the same neurobiological mechanism in which they represent different phenotypic manifestations which run in a continuum [28]. The association between neuroticism and anxiety disorders, particularly generalized anxiety disorder and panic disorder, is well documented in the general population [29]. People with trait neuroticism tend to utilize maladaptive forms of emotional regulation rather than reappraisal which is believed to increase the severity of anxiety symptoms in these individuals [30]. Unexpectedly, our findings indicated that higher physical health-related QOL increases the odds of anxiety in diabetic patients. This is contradictory to previous findings which suggest anxiety is inversely correlated with all the components of QOL [31].

However, higher psychological QOL reduced the odds of anxiety disorders in diabetic patients, which is in line with the findings of other studies on patients with diabetes [31, 32].

Our study indicated that among demographic and social characteristics, older age and those with regular religious practice reduced odds of depression (by 0.96-fold and 0.08-fold respectively). Regarding clinical characteristics, those with anxiety had a 20-fold increased odds of developing depression. Greater physical health-related QOL reduced the occurrence of depression by 0.7-fold. Several studies have suggested that spirituality and religiosity are protective factors against depression [33–35]. In our sample, 79% of participants within the elderly age group (median age of 63 years) reported having a strong religious practice and those who have strong religious practice also had reduced odds of developing depression. Hence, strong religious practice could mediate the protective effect of older age against depression in our study. A bidirectional relationship between mood disorders and diabetes has been proposed, and the occurrence of anxiety is known to increase the risk of developing depression among patients [26, 27]. Our findings further support a bidirectional association between anxiety and depression among patients with diabetes, as reported by previous studies [9, 25]. We found that greater physical health-related QOL acts as a protective factor to reduce the odds of depression in diabetic patients. Similar results were found in a systematic review of 20 studies of diabetic patients across Europe and the United States [36]. Regarding personality traits, unlike previous studies in the general population, our findings did not suggest a predictive effect of neuroticism, extraversion, or conscientiousness on depression in patients with diabetes. This discrepancy may be explained by the presence of negative life events, a mediating factor in the relationship between personality traits and depression [37]. Many participants reported strong social support (80.3%). This factor coupled with a potential absence of current negative life events may reduce the predictive effect of neuroticism, extraversion, and conscientiousness on depression. Although our study did not assess negative life events, it may be the mediating factor which links personality traits to depression in diabetic patients.

The current study should be considered in light of its limitations. First, this study was conducted in a single tertiary healthcare referral centre. Hence, the findings may not be generalizable to the entire diabetic population in the country. Second, the cross-sectional design of the study does not allow determination of the causal relationship between the associated factors, depression and anxiety. Third, the depressive and anxiety symptoms were measured by self-reported tools rather than diagnostic interviews, which may affect the reliability of participant classification into the depressive and anxiety groups.

Despite these limitations, the study had many strengths. The data obtained included a wide range of factors that could potentially be associated with depression and anxiety in diabetic patients. The study sample demonstrated diagnostic heterogeneity (patients with type 1, type 2, and gestational diabetes were included), representative of the Malaysian diabetic population. Our study examined the association between personality traits, quality of life, depression, and anxiety in patients with diabetes, which has previously been poorly characterized. Our study highlights a need to screen not only for psychiatric

complications of diabetes, such as depression and anxiety, but also personality traits and quality of life. Hence, management of diabetes mellitus requires a multidisciplinary team that can manage both physical and mental health of patients.

Conclusions

The ADAPT-DM study reported a relatively lower prevalence of anxiety and similar prevalence of depression in a large and heterogeneous sample of Malaysian diabetic patients as compared to studies in other countries. Co-morbid depression, neuroticism, and greater physical health-related QOL increased odds of developing anxiety. Greater psychological QOL was protective against occurrence of anxiety. Co-morbid anxiety increased the odds of developing depression, while older age and greater physical health-related QOL were protective against depression. Our findings indicate that screening for personality traits and QOL are necessary to manage anxiety and depression are necessary for a holistic approach of diabetic treatment.

Abbreviations

QOL: quality of life; BMI= body mass index; GAD: generalized anxiety disorder; IQR: interquartile range; OR: odds ratio; 95% CI: 95% confidence interval; ADAPT-DM: Anxiety, Depression, and Personality Traits in Diabetes Mellitus; UKMMC: Universiti Kebangsaan Malaysia Medical Centre; GAD-7: Seven-item Generalised Anxiety Disorder scale; BDI: Beck Depression Inventory-II; BFI: Big Five Inventory; WHOQOL-BREF: World Health Organization Quality of Life-BREF

Declarations

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Authors' contributions

LWS-C lead the study. PJG, RLM, ESK, NHH, PA, AYZ, and NM collected the data. MFILBA prepared the original draft. HS and AR reviewed and edited the final manuscript.

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Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

Ethics approval and consent to participate

Ethics approval was obtained from Human Ethics Committee of the Faculty of Medicine, Universiti Kebangsaan Malaysia (UKM FPR.SPI 800-2/28/166/FF-2019-342). All procedures performed in this study involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments. Written informed consent was provided by the participants of the study.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Tables

Table 1. Socio-demographic, social and clinical characteristics of the participants

Variables	N	%
Age (N=300)	63 ^a	16 ^b
Gender		
Male	158	52.7
Female	141	47.0
Missing	1	0.3
Ethnicity		
Malay	195	65.0
Chinese	54	18.0
Indian	44	14.7
Others	7	2.3
Marital status		
Married	231	77.0
Single	24	8.0
Divorced/widowed	43	14.3
Education		
None	7	2.3
Primary	38	12.7
Secondary	133	44.3
Tertiary	119	39.7
Missing	3	1.0
Employment		
Employed	80	26.7
Unemployed	94	31.3
Retired	123	41.0
Missing	3	1.0
Household income		
<RM3,000	166	55.3
RM3,000-6,000	57	19.0
>RM6,000	61	20.3

Missing	16	5.3
Religion		
Islam	199	66.3
Buddhism	37	12.3
Hindusim	35	11.7
Christianity	23	7.7
Others	4	1.3
Missing	2	0.7
Regular religious practice		
Disagree	19	6.3
Neutral	43	14.4
Agree	237	79.0
Missing	1	0.3
Smoking		
Never	216	72.0
Ex-smoker	64	21.3
Current smoker	20	6.7
Alcohol use		
Yes	26	8.7
No	271	90.3
Missing	2	0.7
Recreational drug use		
Yes	5	1.7
No	294	98.0
Missing	1	0.3
Perceived social support		
Poor	10	3.4
Neutral	48	16.0
Good	241	80.3
Missing	1	0.3
Diabetes type		

Type 1	22	7.3
Type 2	269	89.7
Gestational	6	2.0
Missing	3	1.0
Duration of DM (years) (N=229)	14 ^a	12 ^b
Insulin therapy		
Yes	138	46.0
No	114	38.0
Missing	48	16.0
HbA1c (%) (N=268)	7.6 ^a	2.7 ^b
Diabetic control		
Good	92	30.7
Poor	208	69.3
"I am able to manage my diabetes well"		
Disagree	15	5.0
Neutral	70	23.4
Agree	214	71.3
Missing	1	0.3
Obesity		
BMI <25	65	21.7
BMI 25-30	147	49.0
BMI >30	78	26.0
Missing	10	3.3
Hypertension		
Yes	222	74.0
No	78	26.0
Dyslipidaemia		
Yes	152	50.7
No	148	49.3
Ischaemic heart disease		
Yes	82	27.3

No	218	72.7
Stroke		
Yes	27	9.0
No	273	91.0
Renal disease		
Yes	53	17.7
No	247	82.3
Anxiety (GAD-7)		
Yes	27	9.0
No	273	91.0
Depression (BDI)		
No/minimal	240	80.0
Mild to moderate	41	13.7
Moderate to severe	17	5.7
Severe	2	0.7
WHOQOL-BREF		
Overall perception of QOL		
Very poor	3	1.0
Poor	5	1.7
Neither poor nor good	89	29.7
Good	162	54.0
Very good	41	13.7
Overall perception of health		
Very dissatisfied	1	0.3
Dissatisfied	37	12.3
Neither satisfied nor dissatisfied	131	43.7
Satisfied	121	40.3
Very satisfied	10	3.3
WHOQOL-BREF domains (N=300)		
Physical health	14.29 ^a	3.43 ^b
Psychological	15.33 ^a	2.67 ^b

Social relationships	16.00 ^a	2.67 ^b
Environment	15.00 ^a	2.50 ^b
BFI subscales (N=300)		
Extraversion	3.38 ^a	0.75 ^b
Agreeableness	3.78 ^a	0.43 ^b
Conscientiousness	3.67 ^a	0.60 ^b
Neuroticism	2.50 ^a	0.73 ^b
Openness	3.30 ^a	0.60 ^b

^a= Median; ^b= Interquartile range (IQR)

Table 2. The association between individual socio-demographic, social and clinical characteristics, and anxiety among participants

Variables	Anxiety (N=27)		No anxiety (N=273)		p values
	Median	IQR	Median	IQR	
Age (N=300)	60.00	15.00	63.00	16.50	0.490 ^a
BFI subscales (N=300)					
Extraversion	3.13	0.85	3.38	0.75	0.031 ^{a*}
Agreeableness	3.56	0.78	3.80	0.46	0.004 ^{a*}
Conscientiousness	3.56	0.89	3.67	0.60	0.279 ^a
Neuroticism	3.13	0.58	2.38	0.75	<0.001 ^{a*}
Openness	3.40	0.80	3.25	0.60	0.065 ^a
WHOQOL-BREF domains (N=300)					
Physical health	12.57	4.00	14.29	3.43	<0.001 ^{a*}
Psychological	12.67	4.00	15.33	2.67	<0.001 ^{a*}
Social relationships	12.00	4.00	16.00	2.34	<0.001 ^{a*}
Environment	13.00	2.50	15.00	2.50	<0.001 ^{a*}
	N	%	N	%	
Gender (N=300)					
Male	16	59.3	143	52.4	0.484 ^b
Female	11	40.7	130	47.6	
Ethnicity (N=300)					
Malay	12	44.4	183	67.0	0.019 ^{b*}
Non-Malay	15	55.6	90	33.0	
Marital status (N=300)					
Married	22	81.5	209	76.6	0.562 ^b
Not married	5	18.5	64	23.4	
Education (N=300)					
Secondary & below	16	59.3	165	60.4	0.940 ^b
Tertiary	11	40.7	108	39.6	
Employment (N=300)					
Employed	12	44.4	68	24.9	0.077 ^b
Unemployed	8	29.6	86	31.5	

Retired	7	25.9	119	43.6	
Household income (N=300)					
<RM3,000	21	77.8	161	59.0	0.134 ^c
RM3,000-6,000	3	11.1	54	19.8	
>RM6,000	3	11.1	58	21.2	
Regular religious practice (N=300)					
Disagree	4	14.8	15	5.5	0.087 ^c
Neutral	2	7.4	41	15.0	
Agree	21	77.8	217	79.5	
Smoking (N=300)					
Non-smoker	24	88.9	256	93.8	0.406 ^c
Smoker	3	11.1	17	6.2	
Alcohol (N=300)					
Yes	2	3.8	25	9.2	0.712 ^c
No	25	96.2	248	90.8	
Recreational drugs (N=300)					
Yes	1	3.7	5	1.8	0.379 ^c
No	26	96.3	268	98.2	
Obesity (N=300)					
BMI <25	5	18.5	62	22.7	0.272 ^b
BMI 25-30	15	55.6	138	50.6	
BMI >30	7	25.9	73	26.7	
DM type (N=300)					
Type 2 DM	26	96.3	243	89.0	0.333 ^c
Non type 2	1	3.7	30	11.0	
Insulin therapy (N=300)					
Yes	18	66.7	145	53.1	0.291 ^b
No	9	33.3	128	46.9	
Good self-perceived DM management (N=300)					
Disagree	14	51.9	71	26.0	0.003 ^{b*}
Agree	13	48.1	202	74.0	

Diabetic control (N=300)

Good	6	22.2	86	31.5	0.319 ^b
Poor	21	77.8	187	68.5	

Depression (N=300)

No depression	4	14.8	236	86.4	<0.001 ^{c*}
Depression	23	85.2	37	13.6	

Overall perception of QOL (N=300)

Other	18	66.7	79	28.9	<0.001 ^{b*}
Good/very good	9	33.3	194	71.1	

Overall perception of health (N=300)

Other	22	81.5	147	53.8	0.006 ^{b*}
Satisfied/very satisfied	5	18.5	126	46.2	

^a= Mann-Whitney U test, ^b= Pearson's Chi-square test, ^c= Fisher's exact test, *Statistically significance at p < 0.05

Table 3. The association between socio-demographic, social and clinical characteristics, and depression among participants

Variables	Depression (N=60)		No depression (N=240)		p values
	Median	IQR	Median	IQR	
Age (N=300)	59.00	20.75	64.00	15.00	0.032 ^{a*}
BFI subscales (N=300)					
Extraversion	3.19	0.87	3.38	0.62	0.019 ^{a*}
Agreeableness	3.67	0.56	3.80	0.48	0.013 ^{a*}
Conscientiousness	3.44	0.78	3.67	0.56	0.003 ^{a*}
Neuroticism	2.88	0.63	2.38	0.75	<0.001 ^{a*}
Openness	3.30	0.60	3.25	0.70	0.257 ^a
WHOQOL-BREF domains (N=300)					
Physical health	12.57	2.85	14.86	2.86	<0.001 ^{a*}
Psychological	13.33	3.17	15.33	2.00	<0.001 ^{a*}
Social relationships	12.00	5.33	16.00	1.33	<0.001 ^{a*}
Environment	13.50	3.00	15.43	2.50	<0.001 ^{a*}
	N	%	N	%	
Gender (N=300)					
Male	35	58.3	124	51.7	0.484 ^b
Female	25	41.7	116	48.3	
Ethnicity (N=300)					
Malay	37	61.7	158	65.8	0.545 ^b
Non-Malay	23	38.3	82	34.2	
Marital status (N=300)					
Married	46	76.7	185	77.1	0.945 ^b
Not married	14	23.3	55	22.9	
Education (N=300)					
Secondary & below	38	63.3	143	59.6	0.547 ^b
Tertiary	22	36.7	97	40.4	
Employment (N=300)					
Employed	21	35.0	59	24.6	0.033 ^{b*}

Unemployed	23	38.3	71	29.6	
Retired	16	26.7	110	45.8	
Regular religious practice (N=300)					
Disagree	9	15.0	10	4.2	0.001 ^{b*}
Neutral	9	15.0	34	14.1	
Agree	42	70.0	196	81.7	
Household income (N=300)					
<RM3,000	40	66.7	134	55.8	0.068 ^b
RM3,000-6,000	13	21.6	48	20.0	
>RM6,000	7	11.7	58	24.2	
Smoking (N=300)					
Non-smoker	224	93.3	56	93.3	1.000 ^c
Smoker	16	6.7	4	6.7	
Alcohol (N=300)					
Yes	4	6.7	24	10.0	0.269 ^c
No	56	93.3	216	90.0	
Recreational drugs (N=300)					
Yes	1	1.7	5	2.1	1.000 ^c
No	59	98.3	235	97.9	
Obesity (N=300)					
BMI <25	15	25.0	53	22.0	0.540 ^b
BMI 25-30	28	46.7	123	51.3	
BMI >30	17	28.3	64	26.7	
DM type (N=300)					
Type 2 DM	6	10.0	25	10.4	0.924 ^b
Non type 2	54	90.0	215	89.6	
Insulin therapy (N=300)					
Yes	29	48.3	133	55.4	0.290 ^b
No	31	51.7	107	44.6	
Good self-perceived DM management (N=300)					
Disagree	28	46.7	58	24.2	<0.001 ^{b*}

Agree	32	53.3	182	75.8	
Diabetic control (N=300)					
Good	15	25.0	77	32.1	0.287 ^b
Poor	45	75.0	163	67.9	
Anxiety (N=300)					
No anxiety	37	61.7	236	98.3	<0.001 ^{c*}
Anxiety	23	38.3	4	1.7	
Overall perception of QOL (N=300)					
Other	32	53.3	65	27.1	<0.001 ^{b*}
Good/very good	28	46.7	175	72.9	
Overall perception of health (N=300)					
Other	45	75.0	124	51.7	<0.001 ^{b*}
Satisfied/very satisfied	15	25.0	116	48.3	

^a= Mann-Whitney U test, ^b= Pearson's Chi-square test, ^c= Fisher's exact test, *Statistically significance at p < 0.05

Table 4. Multivariate logistic regression analyses between socio-demographic characteristics, clinical factors and anxiety among participants

Variables	<i>p</i> values	Adjusted OR	95% CI for OR	
			Lower	Upper
Ethnicity				
Non-Malay		1.00		
Malay	0.431	0.62	0.18	2.06
Self-perceived DM management				
Poor		1.00		
Good	0.201	0.37	0.08	1.71
Depression				
No		1.00		
Yes	<0.001*	24.91	5.67	109.42
Overall perception of QOL	0.704	1.33	0.31	5.70
Overall perception of health	0.681	1.38	0.30	6.39
Extraversion	0.349	2.08	0.45	9.71
Agreeableness	0.414	0.49	0.09	2.71
Neuroticism	0.004*	9.24	2.03	42.03
Physical health	0.024*	1.67	1.07	2.59
Psychological	0.008*	0.41	0.21	0.79
Social relationships	0.316	0.86	0.64	1.16
Environment	0.138	1.47	0.88	2.44

*Statistically significance at $p < 0.05$

Table 5. Multivariate logistic regression analyses between socio-demographic characteristics, clinical factors and depression among participants

Variables	<i>p</i> values	Adjusted OR	95% CI for OR	
			Lower	Upper
Age	0.010*	0.95	0.92	0.99
Employment				
Retired		1.00		
Employed	0.636	0.77	0.27	2.24
Unemployed	0.889	0.92	0.27	3.08
Regular religious practice				
Disagree		1.00		
Neutral	0.081	0.16	0.02	1.25
Agree	0.011*	0.08	0.01	0.56
Self-perceived DM management				
Disagree		1.00		
Agree	0.829	0.95	0.61	1.50
Anxiety				
No		1.00		
Yes	<0.001*	30.50	6.82	136.43
Overall perception of QOL	0.532	1.24	0.64	2.40
Overall perception of health	0.219	1.51	0.78	2.93
Extraversion	0.593	1.29	0.50	3.32
Agreeableness	0.377	1.66	0.54	5.12
Conscientiousness	0.389	0.60	0.19	1.93
Neuroticism	0.326	1.60	0.63	4.09
Physical health	<0.001*	0.67	0.53	0.83
Psychological	0.450	0.87	0.62	1.24
Social relationships	0.115	0.84	0.67	1.05
Environment	0.410	1.14	0.83	1.57

*Statistically significance at $p < 0.05$

