

Article

Dose-Dependent Association Between Chronic Complication Burden and Multi-Psychosocial Conditions in Adults with Diabetes

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Abstract

(1) Background: Depression, anxiety, and diabetes-related distress commonly coexist in adults with diabetes and may contribute to cumulative psychosocial burden. This study examined the prevalence of multi-psychosocial burden and its association with chronic diabetes-related complications. (2) Methods: A cross-sectional study was conducted among 172 adults with diabetes using the Patient Health Questionnaire-9, Generalized Anxiety Disorder-7, and Diabetes Distress Scale. Multi-psychosocial burden was defined as the presence of at least two positive psychosocial conditions. Sociodemographic and clinical data were collected through structured assessment and medical record review. (3) Results: The mean age was 58.3 ± 10.4 years, and 57.6% were female. Overall, 16.9% of participants met criteria for multi-psychosocial burden. Chronic diabetes-related complications were present in 47.7% of participants. Each additional chronic complication was independently associated with higher odds of multi-psychosocial burden (adjusted OR 1.92, 95% CI 1.21–3.05; $p = 0.005$). The prevalence of multi-psychosocial burden increased from 8.9% among participants without complications to 37.9% among those with two or more complications, demonstrating a dose-dependent pattern. (4) Conclusions: Chronic complication burden was independently associated with concurrent psychosocial conditions in adults with diabetes, supporting the importance of routine psychosocial screening in patients with chronic complications, while future longitudinal studies are needed to clarify causal pathways.



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Keywords: diabetes mellitus; complications of diabetes; depression; anxiety; diabetes distress; psychosocial burden

1. Introduction

Diabetes mellitus is a major global public health problem affecting more than 500 million people worldwide, with prevalence continuing to increase rapidly, particularly in low- and middle-income countries [1]. In Mongolia, the prevalence of type 2 diabetes has increased substantially during the past two decades, reflecting ongoing demographic, nutritional, and lifestyle transitions [2,3]. In addition to its metabolic and vascular consequences,

diabetes is increasingly recognized as a condition strongly associated with psychosocial and mental health problems.

Depression, anxiety, and diabetes-related distress are among the most common psychosocial conditions observed in adults with diabetes [4–6]. These conditions are associated with impaired self-care behaviors, reduced treatment adherence, poor glycemic control, decreased quality of life, and increased risk of diabetic complications and mortality [7,8]. Diabetes distress, in particular, reflects the emotional burden and challenges associated with long-term disease management and may coexist with depressive and anxiety symptoms [9]. Previous studies have demonstrated substantial overlap among these psychosocial conditions, suggesting that they may cluster together and contribute to cumulative psychosocial burden rather than occurring independently [10,11].

Chronic diabetes-related complications, including retinopathy, nephropathy, neuropathy, cardiovascular disease, and diabetic foot complications, may further increase psychological stress through physical disability, treatment burden, fear of disease progression, and reduced functional capacity [12,13]. Several studies have reported associations between diabetic complications and individual psychosocial outcomes such as depression or anxiety [14,15]. However, limited evidence exists regarding the relationship between chronic complication burden and the coexistence of multiple psychosocial conditions in adults with diabetes, particularly in low- and middle-income settings.

In Mongolia, previous research has primarily focused on the epidemiology and clinical management of diabetes, while studies examining psychosocial burden among people with diabetes remain limited. Furthermore, few studies have evaluated depression, anxiety, and diabetes distress simultaneously using validated assessment tools. Understanding the clustering of psychosocial conditions and their relationship with chronic complications may help identify high-risk patient groups requiring integrated psychosocial care.

Therefore, this study aimed to determine the prevalence of multi-psychosocial burden among adults with diabetes and to examine its association with chronic diabetes-related complications and other sociodemographic and clinical factors.

2. Materials and Methods

2.1. Study Design and Participants

A cross-sectional study was conducted in 2025 at the Central Hospital of Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia. The study included adults aged 18 years and older with a confirmed diagnosis of type 2 diabetes mellitus who attended outpatient follow-up services during the study period. According to hospital registration records, 318 patients with type 2 diabetes had attended follow-up visits during the previous six months. From this population, participants were randomly selected after assessment of eligibility criteria. The sample size was estimated using a single-population proportion formula with a 95% confidence level, 5% margin of error, and an expected prevalence of 50% to provide the maximum required sample size. Based on the accessible source population of 318 adults with type 2 diabetes who attended follow-up visits during the previous six months, finite population correction yielded a minimum required sample size of 170 participants.

Participants were eligible if they had a confirmed diagnosis of type 2 diabetes mellitus and were able to complete the study questionnaires independently. Patients with severe acute medical illness, cognitive impairment, severe psychiatric disorder preventing participation, or inability to complete questionnaires were excluded. In addition, individuals who had experienced major stressful life events during the previous year, including bereavement, severe illness, violence, accidents, or major financial difficulties, were excluded to minimize

potential confounding effects on psychosocial outcomes. After application of inclusion and exclusion criteria, a total of 172 participants were included in the final analysis.

The study protocol adhered to the principles of the Declaration of Helsinki and was approved by the Medical Ethics Committee of the Ministry of Health, Mongolia (Approval No: 24-25/10-1, dated 12 June 2025).

2.2. Data Collection

Sociodemographic, behavioral, and clinical information was collected using structured questionnaires and medical record review. Sociodemographic variables included age, sex, marital status, educational level, and employment status. Behavioral characteristics included smoking status, alcohol consumption during the previous 12 months, physical activity, vegetable intake, self-monitoring of blood glucose, and history of hypoglycemia.

Clinical variables included diabetes duration, insulin use, glycated hemoglobin (HbA1c), and diabetes-related chronic complications. Information regarding chronic complications was initially collected through participant self-report questionnaires and subsequently verified using available clinical registration records and medical charts. Chronic diabetes-related complications included diabetic retinopathy, nephropathy, diabetic foot complications, stroke, and myocardial infarction. Complication burden was categorized as no complications, one complication, or two or more complications.

2.3. Psychosocial Assessment

Psychosocial conditions were assessed using Mongolian-language versions of three validated self-report instruments: the Patient Health Questionnaire-9 (PHQ-9), the Generalized Anxiety Disorder-7 (GAD-7), and the Diabetes Distress Scale (DDS) [16]. The Mongolian PHQ-9 and GAD-7 have recently demonstrated satisfactory psychometric properties in a validation study of Mongolian young adults [17]. The Mongolian version of the DDS has also undergone translation and psychometric validation within Mongolia; however, this validation work has not yet been published in an international peer-reviewed journal. All three instruments were therefore considered appropriate for assessing psychosocial symptoms in the present study. These instruments are intended to identify clinically significant symptoms and psychosocial distress and do not replace formal psychiatric diagnosis based on structured clinical interviews.

Depressive symptoms were evaluated using the PHQ-9, a widely used screening instrument based on the diagnostic criteria for major depressive disorder. The PHQ-9 consists of nine items assessing depressive symptoms experienced during the previous two weeks. Each item is scored from 0 (“not at all”) to 3 (“nearly every day”), resulting in a total score ranging from 0 to 27. Scores of 0–4 indicate minimal depressive symptoms, 5–9 mild depression, 10–14 moderate depression, 15–19 moderately severe depression, and 20–27 severe depression. In this study, moderate-to-severe depression was defined as a PHQ-9 score ≥ 10 .

Anxiety symptoms were assessed using the GAD-7 questionnaire, which measures the frequency of generalized anxiety symptoms during the previous two weeks. The instrument includes seven items scored from 0 to 3, with total scores ranging from 0 to 21. Scores of 5, 10, and 15 represent mild, moderate, and severe anxiety symptoms, respectively. Moderate-to-severe anxiety was defined as a GAD-7 score ≥ 10 .

Diabetes-related emotional distress was evaluated using the Diabetes Distress Scale (DDS), which assesses emotional burden and stress specifically related to living with and managing diabetes. The DDS contains 17 items scored on a 6-point Likert scale ranging from 1 (“not a problem”) to 6 (“a very serious problem”). Mean item scores were calculated by dividing the total score by the number of completed items. Mean scores < 2.0 indicate

little or no distress, scores between 2.0 and 2.9 indicate moderate distress, and scores ≥ 3.0 indicate high diabetes distress. In this study, high diabetes distress was defined as a DDS mean score ≥ 3 .

Multi-psychosocial burden was operationally defined as the presence of at least two positive psychosocial conditions among moderate-to-severe depression, moderate-to-severe anxiety, and high diabetes distress. Because no universally accepted definition of multi-psychosocial burden currently exists in diabetes research, we established an investigator-defined operational definition a priori. Multi-psychosocial burden was defined as the presence of at least two positive psychosocial screening instruments among moderate-to-severe depressive symptoms (PHQ-9 ≥ 10), moderate-to-severe anxiety symptoms (GAD-7 ≥ 10), and high diabetes distress (DDS mean score ≥ 3). This composite outcome was intended to identify the coexistence of clinically relevant psychosocial conditions rather than an isolated positive screen.

2.4. Statistical Analysis

Descriptive statistics were calculated for all variables. Continuous variables were presented as mean $\pm$ standard deviation (SD) or median with interquartile range (IQR), depending on distribution. Categorical variables were presented as frequencies and percentages. Group comparisons were performed using Student's *t*-test, Mann–Whitney U test, chi-square test, or Fisher's exact test, as appropriate.

Correlations among psychosocial measures were assessed using Pearson correlation analysis. Logistic regression analyses were conducted to evaluate factors associated with multi-psychosocial burden and individual psychosocial outcomes. Variables with clinical relevance or statistical significance in bivariable analyses were included in multivariable models. Because of the limited number of outcome events, the primary model was intentionally restricted to minimize the risk of model overfitting and unstable parameter estimates. In addition, a fully adjusted sensitivity analysis was performed including age, sex, HbA1c, diabetes duration, insulin use, smoking status, alcohol consumption, physical activity, vegetable intake, home glucose monitoring, and complication count to evaluate the robustness of the primary findings. Complete results for all covariates in this model are presented in Supplementary Table S1. Odds ratios (ORs) and 95% confidence intervals (CIs) were reported.

All statistical analyses were carried out using IBM SPSS Statistics, Version 28.0. A *p*-value < 0.05 was considered statistically significant.

3. Results

3.1. Participant Characteristics

A total of 172 adults with diabetes were included in the analysis. The mean age was 58.3 ± 10.4 years, and 57.6% ($n = 99$) were female. Most participants were married (85.5%), and 51.5% had attained higher education. Regarding employment status, 52.4% were retired, and 32.9% were currently employed. The median HbA1c was 9.0% (IQR 7.5–11.05), and the median duration of diabetes was 10.0 years (IQR 6.0–16.0). Most participants reported self-monitoring of blood glucose (78.5%), and 53.5% attended physician follow-up visits every three months. Overall, 36.8% were insulin users and 40.6% had received formal diabetes education. Regarding lifestyle factors, 27.9% were current smokers and 34.5% reported alcohol consumption within the past 12 months. Physical inactivity was reported by 45.0% of participants. Frequent hypoglycemia (weekly or more often) was reported by 5.3%. Overall, 47.7% had at least one chronic diabetes-related complication. By complication category, 52.6% had no complications, 30.4% had one complication, and 17.0% had two or more complications. The most frequently reported complications were

retinopathy (28.5%), nephropathy (17.4%), diabetic foot complications (15.7%), and prior stroke or myocardial infarction (8.1%).

3.2. Distribution of Psychosocial Conditions

Among participants, 73.3% had no psychosocial condition. A single condition was present in 9.9%, including depression only (5.8%), anxiety only (1.7%), or diabetes distress only (2.3%, Table 1). Two conditions were present in 10.5%, most commonly co-occurring depression and anxiety (5.2%). All three conditions—depression, anxiety, and diabetes distress—were observed in 6.4% ($n = 11$). Overall, 16.9% ($n = 29$) met criteria for multi-psychosocial burden (≥ 2 conditions).

Table 1. Distribution of psychosocial conditions.

Psychosocial Profile	<i>n</i>	%
No condition (PHQ-, GAD-, DDS-)	126	73.3
Single condition only	17	9.9
Depression only	10	5.8
Anxiety only	3	1.7
Diabetes distress only	4	2.3
Two conditions	18	10.5
Depression + Anxiety	9	5.2
Depression + Distress	5	2.9
Anxiety + Distress	4	2.3
All three conditions	11	6.4

Data are presented as *n* (column %).

Significant positive correlations were observed among depression (PHQ-9), anxiety (GAD-7), and diabetes distress (DDS mean score). Depression was correlated with anxiety ($r = 0.623$, $p < 0.001$) and diabetes distress ($r = 0.536$, $p < 0.001$). Anxiety was also correlated with diabetes distress ($r = 0.604$, $p < 0.001$). Internal consistency across the three psychosocial measures was acceptable (Cronbach's $\alpha = 0.794$).

3.3. Comparison by Psychosocial Burden Status

Participants with multi-psychosocial burden (≥ 2 conditions) were older than those with 0–1 condition ($p = 0.053$). When categorized, the proportion aged ≥ 60 years was higher in the multi-burden group (75.9% vs. 47.6%, $p = 0.020$). Median HbA1c was 9.5% (IQR 8.0–11.8) among participants with ≥ 2 conditions and 9.0% (IQR 7.5–11.0) among those with 0–1 condition ($p = 0.124$). Median diabetes duration was 10 years in both groups ($p = 0.504$, Table 2).

Participants with ≥ 2 psychosocial conditions had a higher median number of chronic complications ($p < 0.001$, Table 2). The prevalence of any chronic complication was higher in the multi-burden group (72.4% vs. 41.5%, $p = 0.002$). The distribution across complication categories differed between groups ($p = 0.001$); 37.9% of participants with multi-psychosocial burden had two or more complications compared with 12.3% in the 0–1 condition group.

No statistically significant differences were observed between groups with respect to sex, marital status, education level, employment status, insulin use, smoking, alcohol consumption, vegetable intake, physical activity, or hypoglycemia frequency (all $p > 0.05$).

Table 2. Characteristics overall and by psychosocial burden (≥ 2 screens).

Characteristic	Total (<i>n</i> = 172)	Condition Presence		<i>p</i> -Value
		0–1 (<i>n</i> = 143)	≥ 2 (<i>n</i> = 29)	
Age (years), mean $\pm$ SD	58.3 $\pm$ 10.4	57.6 $\pm$ 10.5	61.7 $\pm$ 9.1	0.053
Age category, <i>n</i> (%)				0.020
<45	19 (11.0)	17 (11.9)	2 (6.9)	
45–59	63 (36.6)	58 (40.6)	5 (17.2)	
≥ 60	90 (52.3)	68 (47.6)	22 (75.9)	
Male sex, <i>n</i> (%)	73 (42.4)	63 (44.1)	10 (34.5)	0.342
Married/cohabiting, <i>n</i> (%)	150 (87.2)	128 (89.5)	22 (75.9)	0.097
Higher education, <i>n</i> (%)	110 (64.0)	92 (64.3)	18 (62.1)	0.888
Employed, <i>n</i> (%)	57 (33.1)	51 (35.7)	6 (20.7)	0.124
Smokers, <i>n</i> (%)	48 (27.9)	41 (28.7)	7 (24.1)	0.765
Alcohol use (last 12 months), <i>n</i> (%)	59 (34.3)	46 (32.2)	13 (44.8)	0.140
Low vegetable intake, <i>n</i> (%)	17 (9.9)	13 (9.1)	4 (13.8)	0.322
Physically active, <i>n</i> (%)	79 (45.9)	69 (48.3)	10 (34.5)	0.248
Diabetes duration (years), median (IQR)	10 (6–16)	10 (6–15)	10 (7–19)	0.504 †
HbA1c (%), median (IQR)	9.0 (7.5–11.0)	9.0 (7.5–11.0)	9.5 (8.0–11.8)	0.124 †
Insulin user, <i>n</i> (%)	64 (37.2)	52 (36.4)	12 (41.4)	0.556
Hypoglycemia (yes), <i>n</i> (%)	67 (39.0)	52 (36.4)	15 (51.7)	0.103
Any chronic complication, <i>n</i> (%)	82 (47.7)	61 (42.7)	21 (72.4)	0.002
Complication count, median (IQR)	0 (0–1)	0 (0–1)	1 (0–2)	<0.001 †
Complication category, <i>n</i> (%)				0.001
0	94 (54.7)	86 (60.1)	8 (27.6)	
1	52 (30.2)	42 (29.4)	10 (34.5)	
≥ 2	26 (15.1)	15 (10.5)	11 (37.9)	

Data are presented as mean $\pm$ SD, median (IQR), or *n* (column %). Multi-psychosocial burden was defined as ≥ 2 positive screens (PHQ-9, GAD-7, DDS). *p*-values were calculated using *t*-test, Mann–Whitney U test (†), or chi-square/Fisher's exact test, as appropriate. Abbreviations: SD, standard deviation; IQR, interquartile range; HbA1c, glycated hemoglobin.

3.4. Logistic Regression Analyses

As shown in Table 3, in bivariable logistic regression analyses examining predictors of multi-psychosocial burden (≥ 2 vs. 0–1 conditions), each additional chronic complication was associated with higher odds of multi-psychosocial burden (OR = 1.93, 95% CI 1.31–2.87; *p* = 0.001). The presence of any chronic complication (yes vs. no) was also associated with multi-psychosocial burden (OR = 3.53, 95% CI 1.47–8.50; *p* = 0.005). Higher HbA1c was associated with multi-psychosocial burden (per 1% increase: OR = 1.14, 95% CI 1.01–1.28; *p* = 0.040). Age showed a borderline association (per year: OR = 1.04, 95% CI 1.00–1.09; *p* = 0.055). Other sociodemographic, behavioral, and clinical variables were not statistically significant (all *p* > 0.05).

In the multivariable model including complication count and HbA1c (*n* = 152), complication count remained associated with multi-psychosocial burden (adjusted OR = 1.92, 95% CI 1.21–3.05; *p* = 0.005). HbA1c was not statistically significant after adjustment (adjusted OR = 1.11, 95% CI 0.97–1.26; *p* = 0.125, Table 3). In the fully adjusted sensitivity analysis, the association between complication count and multi-psychosocial burden remained robust. Complete estimates for all covariates are provided in Supplementary Table S1.

Table 3. Logistic regression analyses of factors associated with multi-psychosocial burden (≥ 2 conditions).

Predictors	OR	95% CI	p-Value
Bivariable models (unadjusted)			
Age (per 1-year increase)	1.043	0.999–1.088	0.055
Sex (male)	1.496	0.650–3.445	0.344
Married/cohabiting (yes)	0.453	0.169–1.210	0.114
Higher education (yes)	0.945	0.415–2.156	0.894
Employed (yes)	0.475	0.181–1.243	0.129
Diabetes duration (per 1-year increase)	1.021	0.966–1.079	0.464
HbA1c (per 1% increase)	1.136	1.006–1.283	0.040
Home glucose monitoring (yes)	0.370	0.105–1.298	0.121
Diabetes education attended (yes)	2.325	0.929–5.819	0.071
Insulin use (no)	1.260	0.558–2.844	0.579
Any chronic complication (yes)	3.529	1.465–8.500	0.005
Complication count (per 1 additional complication)	1.934	1.305–2.867	0.001
Hypoglycemia (yes)	0.517	0.231–1.157	0.109
Physically active (yes)	0.631	0.272–1.464	0.284
Vegetable intake (per category increase)	0.682	0.393–1.184	0.174
Smoking (yes)	1.288	0.628–2.638	0.490
Alcohol use in last 12 months (yes)	0.547	0.240–1.245	0.150
Multivariable model			
Complication count (per 1 additional complication)	1.922	1.213–3.046	0.005
HbA1c (per 1% increase)	1.105	0.973–1.255	0.125

Bivariable models are unadjusted; the multivariable model includes complication count and HbA1c. Continuous variables are expressed per unit increase. OR, odds ratio; CI, confidence interval; HbA1c, glycated hemoglobin. Multi-psychosocial burden was defined as ≥ 2 positive screens (PHQ-9, GAD-7, DDS).

3.5. Individual Psychosocial Outcomes

In unadjusted analyses, a higher number of chronic complications was associated with moderate-to-severe depression (PHQ-9 ≥ 10 ; OR = 1.85, 95% CI 1.27–2.70; $p = 0.001$), moderate-to-severe anxiety (GAD-7 ≥ 10 ; OR = 2.03, 95% CI 1.36–3.04; $p = 0.001$), and high diabetes distress (DDS ≥ 3 ; OR = 1.52, 95% CI 1.01–2.29; $p = 0.045$).

After adjustment for age, diabetes duration, and HbA1c, complication count remained associated with depression (adjusted OR = 1.94, 95% CI 1.19–3.16; $p = 0.008$), anxiety (adjusted OR = 2.51, 95% CI 1.46–4.31; $p = 0.001$), and diabetes distress (adjusted OR = 1.93, 95% CI 1.11–3.34; $p = 0.020$). In adjusted models, HbA1c was associated with depression (OR = 1.18, 95% CI 1.04–1.33; $p = 0.012$), whereas diabetes duration was not associated with any psychosocial outcome.

3.6. Distribution Across Complication Categories

Figure 1 shows the distribution of psychosocial burden across complication categories. The proportion of participants without psychosocial conditions was 82.2% among those without complications, 71.2% among those with one complication, and 48.3% among those with two or more complications. The prevalence of multi-psychosocial burden was 8.9%, 19.2%, and 37.9%, respectively.

Figure 2 shows the prevalence of individual psychosocial outcomes across complication categories. Moderate-to-severe depression was present in 12.2% of participants without complications, 23.1% of those with one complication, and 41.4% of those with two or more complications. Moderate-to-severe anxiety was observed in 7.8%, 17.3%, and 37.9%, respectively. High diabetes distress was observed in 10.0%, 13.5%, and 27.6%, respectively.

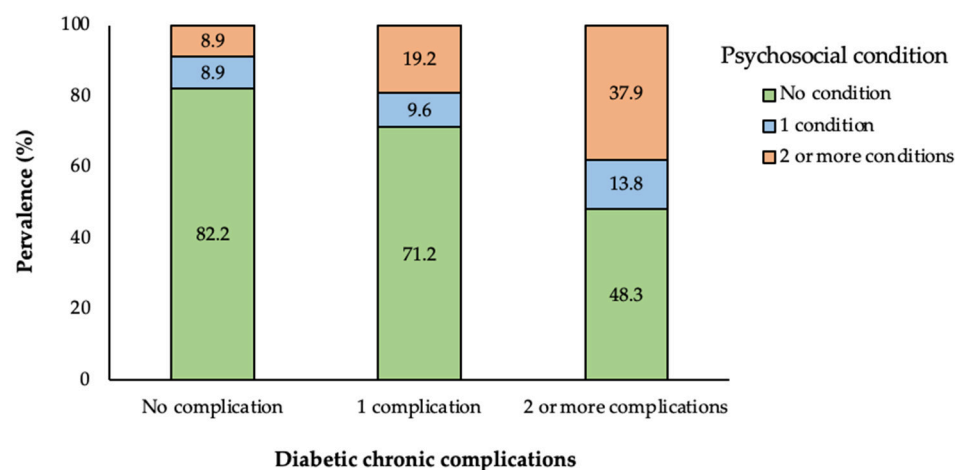


Figure 1. Distribution of psychosocial burden according to number of chronic complications of diabetes.

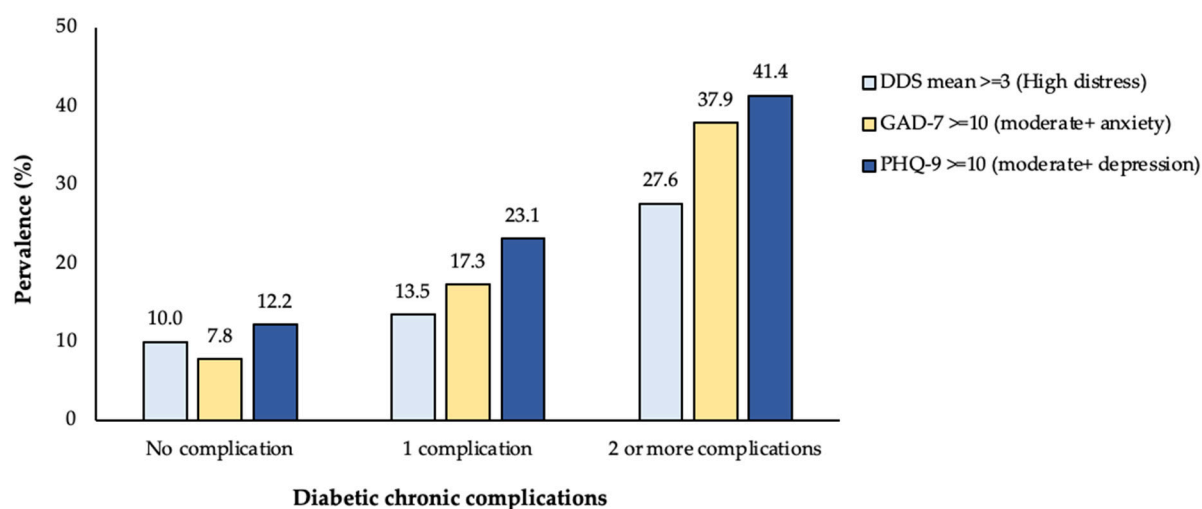


Figure 2. Prevalence of depression, anxiety, and diabetes distress by number of chronic complications of diabetes.

4. Discussion

In this cross-sectional study of adults with type 2 diabetes, approximately one in six participants experienced multi-psychosocial burden, defined as the coexistence of at least two psychosocial conditions including depression, anxiety, and diabetes-related distress. The principal finding of this study was that chronic diabetes-related complication burden demonstrated an independent and dose-dependent association with concurrent psychosocial conditions. Participants with greater numbers of chronic complications had substantially higher prevalence of multi-psychosocial burden as well as higher prevalence of depression, anxiety, and diabetes distress individually. These findings emphasize the importance of considering psychosocial conditions collectively rather than as isolated disorders in diabetes care.

The observed prevalence of multi-psychosocial burden (16.9%) indicates that psychosocial comorbidity represents a clinically meaningful problem among adults with diabetes in Mongolia. Previous international studies have consistently demonstrated elevated prevalence of depression, anxiety, and diabetes distress among individuals with diabetes compared with the general population [4,5,11,15,18]. Meta-analyses have estimated the prevalence of depressive symptoms in adults with diabetes to range between 20% and 30%,

while anxiety symptoms may affect up to one-third of patients [4,15]. Diabetes-related distress has also emerged as a major psychological concern because of the lifelong demands of glucose monitoring, dietary restrictions, fear of complications, and complex treatment regimens [9,19]. However, most previous studies have examined these psychosocial conditions separately, whereas the present study focused on their coexistence and cumulative burden.

Consistent with the previous literature, depression, anxiety, and diabetes distress scores were significantly positively correlated [10,11,19]. These findings support the growing recognition that psychosocial conditions in diabetes are interrelated and may share overlapping emotional, behavioral, and biological pathways. Fisher et al. previously demonstrated that diabetes distress and depression, although conceptually distinct, frequently coexist and may influence one another over time [10,19]. Similarly, Polonsky et al. reported that emotional distress associated with diabetes management is strongly associated with depressive symptoms and reduced quality of life [9]. Our findings further support the concept that psychosocial conditions among people with diabetes should not be evaluated independently, as screening for only one condition may underestimate the overall psychological burden experienced by patients.

The strongest finding of the present study was the robust association between chronic complication burden and psychosocial outcomes. Each additional chronic complication was associated with nearly twofold higher odds of multi-psychosocial burden after adjustment for HbA1c. Furthermore, the prevalence of psychosocial burden increased progressively according to complication category, demonstrating a clear dose-dependent relationship. Participants with two or more chronic complications demonstrated markedly higher prevalence of concurrent psychosocial conditions compared with those without complications. Similar dose-dependent increases were also observed for moderate-to-severe depression, anxiety, and high diabetes distress individually.

These findings are consistent with previous international studies demonstrating associations between diabetic complications and adverse psychological outcomes [7,20–22]. Chronic complications such as retinopathy, nephropathy, diabetic foot disease, stroke, and cardiovascular disease may contribute to psychological burden through pain, disability, reduced independence, impaired mobility, fear of disease progression, and financial stress [13,21,22]. Visual impairment and diabetic foot complications, in particular, may substantially reduce functional capacity and quality of life, thereby increasing vulnerability to depressive and anxiety symptoms [20,23]. In addition, patients with multiple complications often experience greater treatment burden, polypharmacy, more frequent hospital visits, and concerns regarding long-term prognosis, all of which may contribute to emotional distress.

The relationship between psychosocial burden and diabetes-related complications is likely bidirectional. Chronic complications may worsen psychological well-being through pain, disability, reduced independence, fear of disease progression, and increased treatment burden [14,24,25]. Conversely, depression, anxiety, and diabetes distress may negatively affect medication adherence, dietary behaviors, physical activity, glucose monitoring, and clinic attendance, resulting in poorer glycemic control and potentially accelerating the progression of chronic complications. In addition to these behavioral mechanisms, chronic low-grade inflammation, hypothalamic–pituitary–adrenal axis activation, and increased allostatic stress have also been proposed as biological pathways linking diabetes complications and mental health [24,26]. Similarly, diabetes distress has been linked to treatment fatigue, reduced self-efficacy, and impaired diabetes-related decision making [19,27]. Therefore, psychosocial burden may not only represent a consequence of chronic complications but may also contribute to their progression over time.

In unadjusted analyses, although higher HbA1c levels were associated with multi-psychosocial burden, this relationship was attenuated after adjustment for complication count. This finding suggests that chronic diabetes-related complications may represent cumulative disease burden and long-term disease severity beyond glycemic control measured at a single time point. It is also possible that psychosocial burden affects glycemic control indirectly through behavioral mechanisms, including reduced treatment adherence, poorer self-management, and decreased self-efficacy, rather than through direct physiological pathways alone. Previous studies examining the relationship between HbA1c and psychosocial outcomes have produced inconsistent findings [24,26,28]. Some studies reported significant associations between poor glycemic control and depression or distress, whereas others demonstrated only modest relationships after adjustment for disease severity and complications. It is possible that psychosocial burden affects glycemic control indirectly through behavioral mechanisms rather than direct physiological pathways alone.

Interestingly, sociodemographic and lifestyle-related factors including sex, education, smoking, alcohol use, and physical activity were not independently associated with multi-psychosocial burden in the present study. Although some previous studies have identified female sex, lower socioeconomic status, and unhealthy lifestyle behaviors as risk factors for psychosocial disorders among adults with diabetes [21,25], our findings suggest that chronic disease burden may play a more dominant role in this population. However, the relatively modest sample size may have limited statistical power to detect weaker associations.

This study has several important clinical implications. First, psychosocial screening should be integrated into routine diabetes care, particularly among patients with established chronic complications. Current American Diabetes Association guidelines recommend regular psychosocial assessment as part of comprehensive diabetes management [16]. However, implementation remains limited in many clinical settings, particularly in low- and middle-income countries. Second, assessment strategies should evaluate multiple psychosocial domains simultaneously rather than focusing exclusively on depression or anxiety individually. Third, multidisciplinary approaches involving endocrinologists, mental health professionals, nurses, and diabetes educators may help improve both psychological well-being and diabetes-related outcomes.

The present study has several limitations. First, the cross-sectional design precludes conclusions regarding causality or temporal relationships between chronic diabetes-related complications and psychosocial conditions. Therefore, although significant associations were observed, it cannot be determined whether chronic complications increase psychosocial burden or whether psychosocial burden contributes to the development or progression of diabetes-related complications. Future longitudinal studies are required to clarify these temporal relationships. Data were obtained from a single tertiary center and may not fully represent all adults with diabetes in Mongolia. Some complication data were based partly on self-report and therefore may be subject to recall bias despite verification using medical records. Additionally, psychosocial conditions were identified using validated screening instruments rather than structured psychiatric diagnostic interviews. Therefore, the findings reflect clinically significant symptoms identified through screening rather than confirmed psychiatric disorders. Although the overall sample size was adequate for the primary study objective, the relatively limited number of outcome events may have reduced statistical power to detect weaker associations, particularly for sociodemographic and lifestyle-related variables. Therefore, residual confounding and the possibility of Type II error cannot be completely excluded. Finally, some potentially important variables including income, social support, sleep quality, and medication adherence were not evaluated. Despite these limitations, this study provides important evidence regarding the clustering of psychosocial conditions and their relationship with chronic complication burden among

adults with type 2 diabetes in Mongolia. To our knowledge, this is among the first studies in the region to simultaneously evaluate depression, anxiety, and diabetes distress using validated instruments and to examine their cumulative association with diabetes-related complications. Future longitudinal studies are needed to clarify causal mechanisms and determine whether integrated psychosocial interventions may improve both mental health outcomes and long-term diabetes complications.

5. Conclusions

Multi-psychosocial burden was present in approximately one in six adults with type 2 diabetes. Chronic diabetes-related complication burden was independently associated with concurrent psychosocial conditions, demonstrating a clear dose-dependent relationship. These findings support the importance of routine psychosocial screening, particularly among adults with established chronic complications, while future longitudinal studies are needed to clarify causal pathways.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/psychiatryint7040175/s1>, Table S1: Fully adjusted sensitivity analysis of factors associated with multi-psychosocial burden among adults with diabetes.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to ethical/privacy issues.

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