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# Relationship of Diabetes Distress and Depressive Symptoms with Medication Adherence among Patients with Type 2 Diabetes Mellitus Attending Family Medicine Units/Centers in Port Said City

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## ABSTRACT

**Background:** Diabetes distress and depression are known barriers to medication adherence in patients with type 2 diabetes. Limited research has explored this relationship in patients treated at Egyptian family health facilities.

**Objectives:** To assess the association of diabetes distress and depressive symptoms with medication adherence among people with type 2 diabetes attending family medicine units/centers in Port Said City.

**Patients and Methods:** A cross-sectional analytic study included 370 diabetic patients from 5 family health facilities in Port Said City, used convenient sampling. Data were collected using a semi-structured questionnaire, including demographic, disease profiles, the Diabetes Distress Scale (DDS-17), the Patient Health Questionnaire (PHQ-9), the General Medication Adherence Scale (GMAS), and recent HbA1c results.

**Results:** Suboptimal medication adherence (77.03%), depressive symptoms (28.38%), and diabetes distress (35.41%) were prevalent among the participants. Multiple logistic regression analysis revealed that predictors of optimal medication adherence included female gender (OR 2.470, P=0.013), sufficient income (OR 4.703, P<0.001), absence of dyslipidemia (OR 0.273, P=0.002), and absence of depressive symptoms (OR 0.197, P=0.003). Diabetes distress was clinically associated with suboptimal medication adherence, but this association was not statistically significant.

**Conclusion:** Depressive symptoms were associated with suboptimal medication adherence. While diabetes distress showed a clinical link to suboptimal adherence, it was not statistically significant. These findings emphasize the importance of addressing depressive symptoms and monitoring diabetes distress in clinical practice to improve medication adherence**.**

**Keywords:** Depressive symptoms, Diabetes distress, Medication adherence, Primary health care, Type 2 diabetes mellitus.

## INTRODUCTION

Diabetes mellitus (DM) is a prevalent health issue worldwide (10.5%), in the Middle East and North Africa (MENA) Region (16.2%), and in Egypt (20.9%), according to the International Diabetes Federation in 2021. 90% of people with DM have type 2 diabetes (T2DM). It has both acute and long-term problems that lower quality of life, cause financial hardship, and increase the risk of early death. Among people with type 2 diabetes, diabetes distress (DD) is the most prevalent psychiatric co-morbidity. Living with diabetes and managing its everyday demands, such as the risk of complications, self-management, social support, and access to treatment, may lead to unpleasant emotional responses and behavioral changes known as diabetic distress [(1,2)].

According to a recent meta-analysis research conducted in the Netherlands, 36% of individuals with type 2 diabetes have DD. Primary health care (PHC) individuals with type 2 diabetes had significantly lower DD levels and the prevalence of increased DD than secondary health care diabetic patients (4% vs 19%) [(3)]. In Saudi PHC settings, 22.3% of T2DM patients developed DD, according to a recent research conducted in Saudi Arabia [(4)].

Self-efficacy, self-management, adherence to prescribed medicine, and a healthy lifestyle are all negatively correlated with DD, which exacerbates type 2 diabetes. Cohort and longitudinal studies conducted in Germany and Canada have shown that DD may predict the likelihood of depression in individuals with type 2 diabetes on its own. Conversely, depression exacerbates the psychological impact of a diagnosis of diabetes mellitus, leading to a rise in DD [(5)].

According to research in Cambodia, 2.8% of individuals without depression and 50% of patients with depression had suboptimal adherence. The key to effective glycemic management for diabetic patients is medication adherence, as poor adherence raises the risk of diabetes complications, which have a detrimental impact on the patient's quality of life. Frequent usage of healthcare services due to suboptimal adherence to antidiabetic medicines also raises healthcare expenses [(6)].

Recent research in Port-Said, Egypt, revealed that among PHC patients with type 2 diabetes, the prevalence rate of medication adherence was 61.1%. which was less than the results of a prior research conducted in Ismailia, Egypt, among PHC patients with type 2 diabetes (74%) [(7,8)].

Given the burden of diabetes mellitus, poor adherence to anti-diabetic medication, depression, and DD, as well as the paucity of research on the relationship between DD and depressive symptoms with medication adherence in Egyptian PHC attendees with T2DM, this



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study was carried out to evaluate this relationship among T2DM patients who visit family medicine units/centers in Port Said city.

## PATIENTS AND METHODS

Between November 2022 and September 2024, 370 Egyptian patients with type 2 diabetes who were receiving diabetic treatment in family medicine units or facilities in Port Said City, Egypt, participated in this cross-sectional analytical research. Participants in the research were Egyptians with type 2 diabetes who were 18 years of age or older, receiving diabetic treatment at family medical units or clinics, and who had been diagnosed with the disease for at least a year. However, the study did not include pregnant women with gestational diabetes, patients with severe cognitive disorders such as dementia that could affect their ability to communicate or understand questions, patients with hearing impairment that could affect their ability to self-report, or extremely ill patients (such as those with end-stage renal disease, congestive heart failure, and decompensated liver cell failure).

Every patient had their complete medical history taken, including sociodemographic information such as age, gender, marital status, income, education, and work status, lifestyle factors including physical activity and smoking status. Diabetes-related complications (diabetic retinopathy, diabetic nephropathy, peripheral neuropathy, autonomic neuropathy, and cardiovascular disease (CVD)), co-morbidities (hypertension, dyslipidemia, and psychiatric disorder), the number of medications currently taken for diabetes, the number of other medications, and a family history of DM were all included in the disease profile.

The DDS-17, or Diabetes Distress Scale 17: This scale was created by **Polonsky et al.** in 2005. DDS demonstrated strong reliability, a four-factor structure, and acceptable convergent validity. The 17 questions that make up the DDS assess issues connected to diabetes within the last month. Emotional Burden (5 items: questions 1, 3, 8, 11, and 14), Physician related distress (PD) (4 items: questions 2, 4, 9, and 15), Regimen related distress (RD) (5 items: questions 5, 6, 10, 12, and 16), and Interpersonal related distress (ID) (3 items: questions 7, 13, and 17) are the four different subcategories of diabetes-related distress identified by the DDS-17. The four subscales' Cronbach's alphas varied from 0.88 to 0.90, while the overall DDS scale's Cronbach's alpha was 0.93 [(9)].

A 6-point Likert scale was used to score each questionnaire item—1 being not an issue, 2 being a mild problem, 3 being a moderate problem, 4 being a fairly significant problem, 5 being a major problem, and 6 being a very serious problem. A mean score of less than two, between two and 2.9, and ≥3 and, respectively, were the cutoffs for mild, moderate, and extreme distress[(10)].

The Arabic DDS-17, adapted from the Saudi DDS-17 (Cronbach's alpha = 0.848) [(11)], underwent cultural modifications for clarity. Forward and backward translations by bilingual experts ensured consistency. We investigated its reliability and validity on 224 Egyptians with T2DM, demonstrating excellent reliability (α = 0.977) across subscales and a four-factor structure. Convergent validity was confirmed through correlations with depressive symptoms and medication adherence, while discriminant validity differentiated diabetes distress based on glycemic control and related factors.

PHQ9, or the Patient Health Questionnaire 9: It has nine questions and is a self-report depression assessment. Based on how much a symptom has troubled them over the last two weeks, each of the nine things will get a score ranging from 0 (not at all) to 3 (almost every day). For serious depression, a PHQ-9 score of ≥10 yielded an 88% sensitivity and an 88% specificity. The PHQ-9's Cronbach's α was 0.89, indicating the tool's validity and reliability. According to cross-sectional research conducted in Saudi Arabia, the PHQ-9's Arabic translation is accurate and legitimate. Every item has a strong correlation with the whole scale (lowest r=0.378). The range of inter-item correlations is 0.177 to 0.648. 0.857 was the Cronbach's α value [(12)].

The General Medication Adherence Scale (GMAS) is a new self-reporting adherence tool designed for Pakistani patients that was first created in Urdu by **Naqvi *et al.*** [(13)]. The scale has recently been verified in Saudi populations using a translated Arabic version [(14)]. Three significant factors influencing adherence are meant to be measured by this scale: Patient behavior-related non-adherence (PBNA), extra disease and pill burden-related non-adherence (ADPB), and cost-related non-adherence (CRNA) are the three subscales that make up the scale. There are four alternative answers for each of the eleven questions. The scale's domains each assess a distinct aspect of non-adherence. A higher number denotes a better degree of adherence. The total score goes from 0 to 33.

Five categories are created from the final score: partial (17–26), low (11–16), excellent (27–29), high (30–33), and bad (≤10). The authors did not address the procedure in their study, despite having previously established the cut-off value of GMAS at a score of 27 that distinguished between adherent and non-adherent individuals [(15)]. Cronbach alpha was used to analyze the tool's dependability; a value of >0.5 was deemed adequate.

**Measurements and Research:** Weight (in kilograms), height (in centimeters), BMI, blood pressure, and the most recent HbA1c test (less than three months old) are among the measurements. HbA1C readings below 7% in

adults or less than 7.5% in older adults are regarded as favorable indicators of glycemic management [16].

**Pilot study:** At the start of data collection, 50 patients completed the questionnaire. 50 patients with type diabetes who were not included in the sample size were used as a purposive sample.

The researcher conducted an interview with the enrolled patient to get information for the aforementioned questions. Participants' data were collected one or two days a week between 9 a.m. and 1.30 p.m. Interviews were conducted with each participant, and their medical records were updated.

**Ethical approval and consent to participants**

This study was part of a larger study, whose ethical approval was obtained from the Research Ethics Committee of Faculty of Medicine, Suez Canal University, Ismailia, Egypt (Ref No. 4942/2022, dated 19/5/2022). All participants provided informed consent prior to participating in the study. All methods were carried out in accordance with relevant guidelines and regulations.

***Statistical analysis***

Data were analyzed by version 26 of Statistical Package for the Social Sciences (SPSS). Presentation of data had been done in the form of numerical tabular and graphical when appropriate. All categorical variables were summarized as frequencies and percentages (%) and were compared by chi-squared or Fisher exact tests. The distributions of continuous variables were tested for normality with the Shapiro-Wilk test. The mean and standard deviation were used to summarize normally distributed quantitative data, while median and interquartile range were used to summarize non-normally distributed qualitative data.

Spearman test was performed to estimate the correlation of DD, and depressive symptoms with medication adherence among the participants. Binary and multiple logistic regression analysis was used to assess the predictors of symptoms of DD, depressive symptoms, and medication adherence. P-values < 0.05 were considered significant in all statistical analyses**.**

## RESULTS

This study was carried out to assess the association of medication adherence with depressive symptoms and DD among PHC patients with T2DM in Port Said governorate. The mean age for the study participants was 56.75 ± 14.26 years and 67.8% were less than 65 years old. More than half of them (54.1%) were females, 78.4% were married and 34.6% were not working or housewife. The most frequent educational levels they have reached were high school educated (38.4%) and university graduate (27.8%). More than half (52.4%) of the participants perceived their income as insufficient (Table 1).

**Table 1. Sociodemographic characteristics of study participants (n=370)**

| Variable | Frequency (percent) |
|---|---|
| **Age (years)** | |
| Adults <65 years | 251 (67.8%) |
| Older ≥ 65 years | 119 (32.2%) |
| **Gender** | |
| Male | 170 (45.9%) |
| Female | 200 (54.1%) |
| **Marital status** | |
| Single | 15 (4.1%) |
| Married | 290 (78.4%) |
| Divorced | 14 (3.8%) |
| Widow | 51 (13.8%) |
| **Educational Level** | |
| Illiterate | 30 (8.1%) |
| Read and write | 70 (18.9%) |
| Primary school educated | 8 (2.2%) |
| Secondary school educated | 13 (3.5%) |
| High school educated | 142 (38.4%) |
| University graduate | 103 (27.8%) |
| Postgraduate | 4 (1.1 %) |
| **Occupation** | |
| Not working or housewife | 128 (34.6%) |
| Unskilled manual worker | 17 (4.6 %) |
| Skilled manual worker | 25 (6.8 %) |
| Trades | 45 (12.2 %) |
| Semiprofessional | 66 (17.8%) |
| Professional | 36 (9.7 %) |
| Retired | 53 (14.3 %) |
| **Income** | |
| Not enough | 46 (12.4%) |
| Barely enough | 148 (40%) |
| Sufficient for normal and emergent needs | 161 (43.5%) |
| Enough and spared | 15 (4.1%) |

The mean BMI was 2.68±0.49 kg/m$^2$ and 69.7% of the participants were obese. Nearly three-fourths (73.5%) of patients were non-smokers and 33% were practicing exercise. The mean DM duration was 8.99±7.24 years (median was 7 years and the interquartile range was 3-12 years), and 41.1% had diabetes ≤5 years. The most frequent complications were peripheral neuropathy (33.8%), nephropathy (23.2%), diabetic retinopathy (19.7%), and CVD (15.7%).

About 45.5% of participants had hypertension and 32.7% had dyslipidemia. There was a family history in (37.3%) of participants. More than two-thirds of them were on oral hypoglycemic drugs (66.8%), while 19.2% were on combined oral hypoglycemic drugs and insulin. Suboptimal glycemic control was present in 67.8% of the sample (Table 2).

**Table 2.** Clinical characteristics of study participants (n=370)

| Variable | Frequency (percent) |
|---|---|
| **Body mass index** | |
| Normal weight | 5 (1.4%) |
| Overweight | 107 (28.9%) |
| Obese | 258 (69.7%) |
| **Smoking** | |
| Recently smoker | 66 (17.8%) |
| Not smoker | 272 (73.5%) |
| Previous smoker | 32 (8.6%) |
| **Exercise** | |
| No | 248 (67%) |
| Yes | 122 (33%) |
| **DM duration (years)** | |
| ≤ 5 years | 152 (41.1%) |
| 6-10 years | 119 (32.2%) |
| ≥ 10 years | 99 (26.8%) |
| **T2DM complications** | |
| Retinopathy (present) | 73 (19.7%) |
| Nephropathy (present) | 86 (23.2 %) |
| Peripheral neuropathy (present) | 125 (33.8%) |
| Autonomic neuropathy (present) | 31 (8.4 %) |
| CVD (present) | 58 (15.7%) |
| **Comorbidities** | |
| Hypertension (present) | 168 (45.4 %) |
| Dyslipidemia (present) | 121 (32.7%) |
| Psychiatric disorder (present) | 21 (5.7%) |
| **Family history of T2DM** | |
| Present | 138 (37.3 %) |
| **Antidiabetic medications** | |
| Oral hypoglycemic drugs | 247 (66.8%) |
| Insulin | 52 (14.1%) |
| Oral hypoglycemic drugs plus insulin | 71 (19.2%) |
| **Glycemic control** | |
| Not controlled | 251 (67.8%) |
| Controlled | 119 (32.2%) |

*Cardiovascular disease (CVD)
*Type 2 diabetes mellitus (T2DM)

Figure 1 shows that 35.41% of study participants had diabetes distress and 64.59% of them had moderate distress.

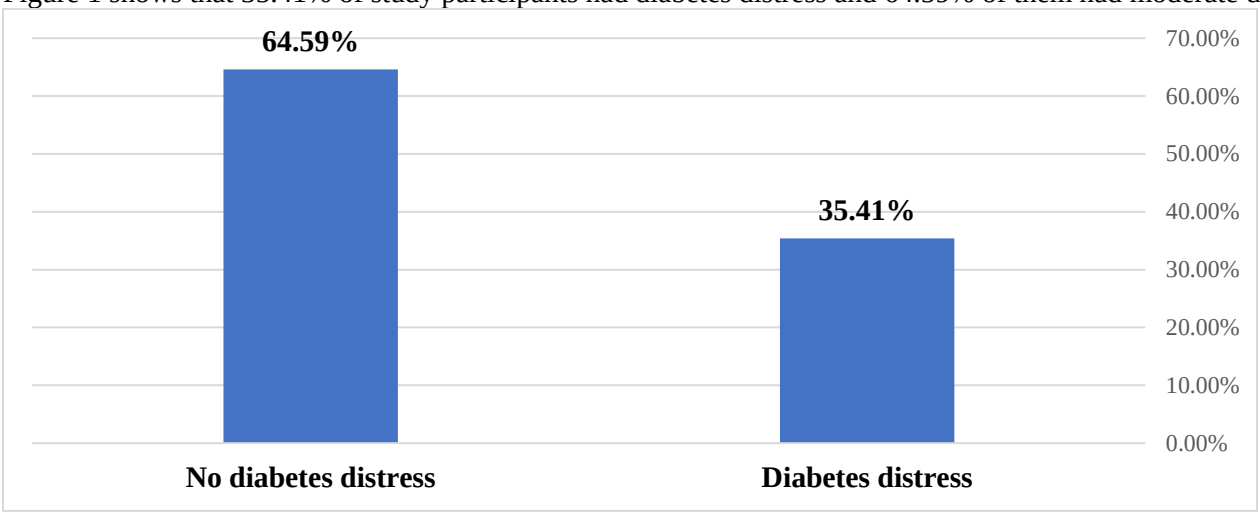


**Figure 1. Prevalence of diabetes distress among study participants (n=370)**

Figure 2 illustrates that most of the study participants (84.10%) had emotional-related distress, 45.40% of them had regimen-related distress.

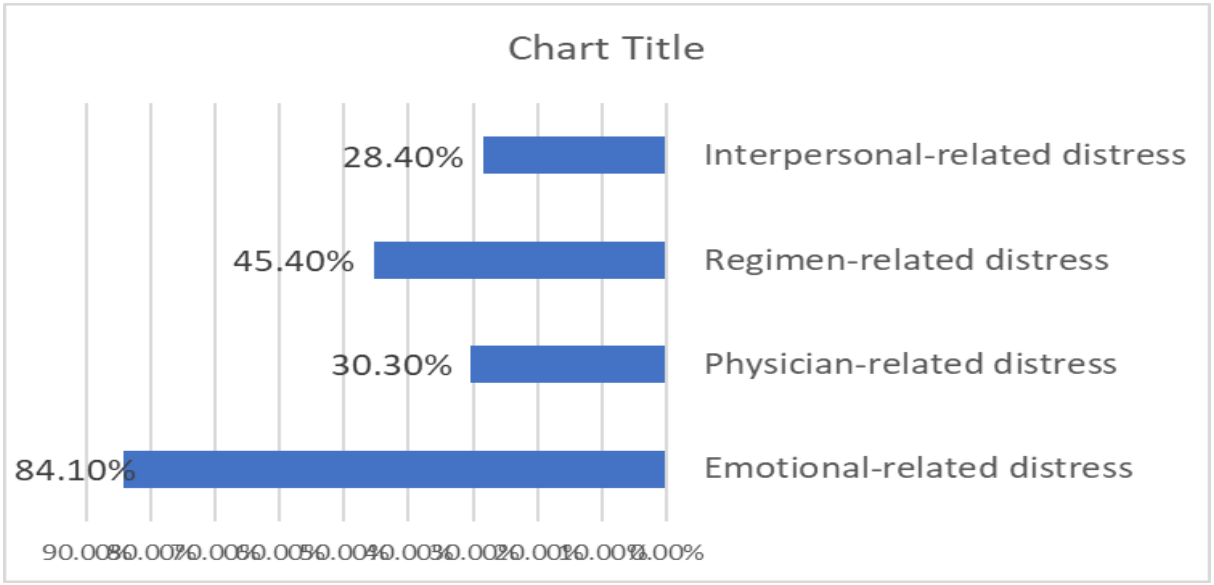


**Figure 2. Frequency distribution of subdomains (subscales) of diabetes distress among study participants (n=370).**

Figure 3 demonstrates that 28.38% of study participants had depressive symptoms and 71.62%of them had no depressive symptoms.

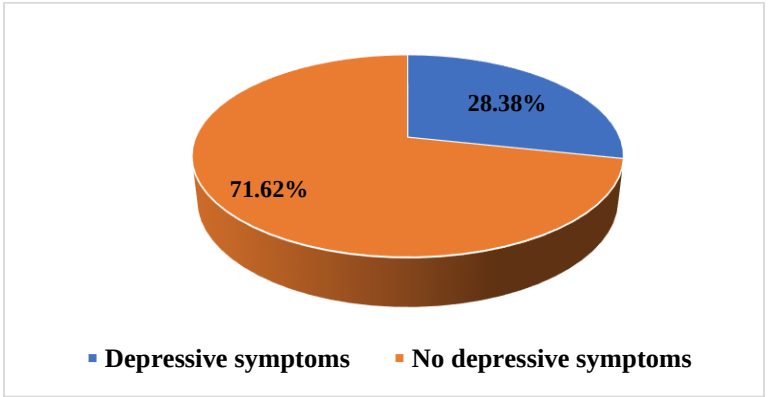


**Figure 3. Frequency distribution of depressive symptoms among study participants (n=370)**

Figure 4 shows that 77.03% of the participants had suboptimal medication adherence, while 22.97% of them have optimal adherence.

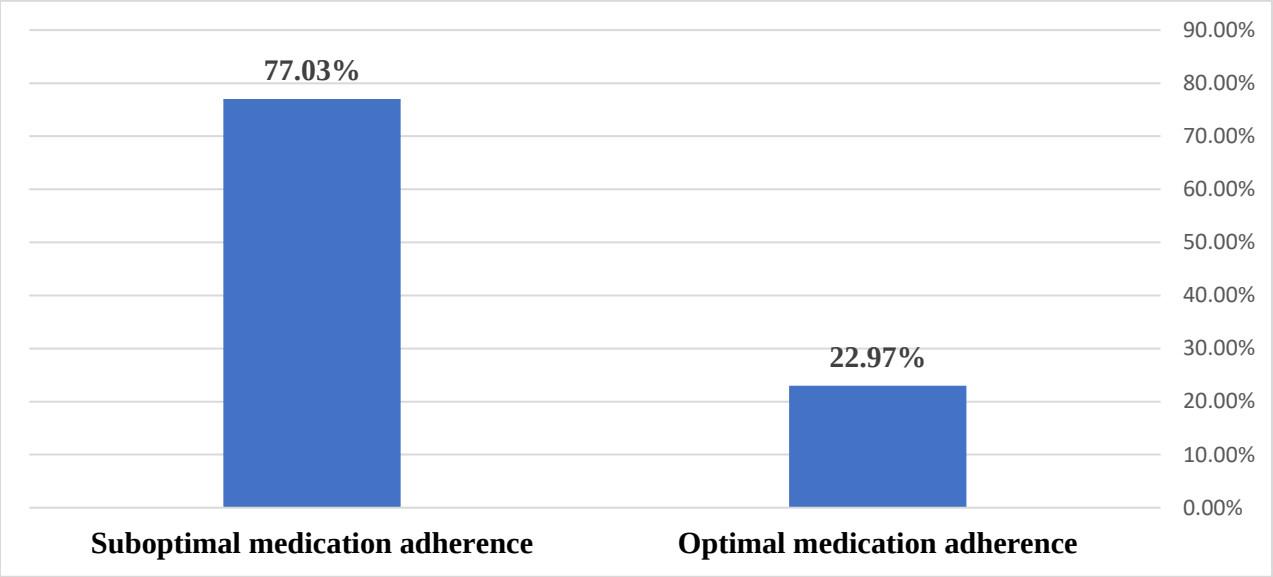


**Figure 4. Frequency distribution of medication adherence among study participants (n=370)**

Medication adherence was significantly associated with gender, age, educational level, occupation, and income. However. medication adherence was not significantly associated with marital status (Table 3).

**Table 3. Association of Medication Adherence with sociodemographic characteristics among study participants (n=370)**

| Variable | Optimal medication adherence | | Test value | P value |
|---|---|---|---|---|
| | Absent N (%) | Present N (%) | | |
| **Gender** | | | | |
| Male | 143 (50.2%) | 27 (31.8%) | 8.936 | **0.003*** |
| Female | 142 (49.8%) | 58 (68.2%) | | |
| **Age** | | | | |
| Adult < 65 years | 185(64.9%) | 66 (77.6%) | 4.867 | **0.027*** |
| Older ≥ 65 years | 100 (35.1%) | 19 (22.4%) | | |
| **Marital Status** | | | | |
| Not married | 58 (20.4%) | 22 (25.9%) | 1.182 | 0.277 |
| Married | 227 (79.6%) | 63 (74.1%) | | |
| **Educational Level** | | | | |
| Illiterate | 90 (31.6%) | 10 (11.8%) | 39.149 | **<0.001*** |
| Educated | 135 (47.4%) | 28 (32.9%) | | |
| Highly educated | 60 (21.1%) | 47 (55.3%) | | |
| **Occupation** | | | | |
| Not working | 138 (49.3%) | 43 (47.8%) | 11.921 | **0.003*** |
| Working | 40 (14.3%) | 2 (2.2%) | | |
| Professional work | 102 (36.4%) | 45 (50.0%) | | |
| **Income** | | | | |
| Not enough | 40 (14.0%) | 6 (7.1%) | 47.425 | **<0.001*** |
| Barely enough | 137 (48.1%) | 11 (12.9%) | | |
| Sufficient for normal and emergent needs | 98 (34.4%) | 63 (74.1%) | | |
| Enough and spared | 10 (3.5%) | 5 (5.9%) | | |
| *p is significant at the level <0.05, Chi-square test was used | | | | |

Medication adherence was associated with retinopathy, nephropathy, peripheral neuropathy and autonomic neuropathy. It was also associated with hypertension, dyslipidemia, psychiatric disease, and medications other than antidiabetic drugs. Medication adherence was not associated with glycemic control, family history of T2DM, antidiabetic medications, BMI, smoking, exercise, and DM duration (Table 4).

**Table 4. Association of medication adherence with clinical characteristics among study participants (n= 370)**

| Variable | Optimal medication Adherence | | Test value | P value |
|---|---|---|---|---|
| | Absent | Present | | |
| **Smoking** | | | | |
| Recent smoking | 56 (19.6%) | 10 (11.8%) | 4.431 | 0.109[a] |
| Not smoking | 202 (70.9%) | 70 (82.4%) | | |
| Previous smoking | 27 (9.5%) | 5 (5.9%) | | |
| **Exercise** | | | | |
| Yes | 96 (33.7%) | 26 (30.6%) | 0.284 | 0.594[a] |
| No | 189 (66.3%) | 59 (69.4%) | | |
| **DM duration (years)** | | | | |
| ≤ 5 years | 111 (38.9%) | 41 (48.2%) | 3.263 | 0.196[a] |
| 6-10 years | 92 (32.3%) | 27 (31.8%) | | |
| > 10 years | 82 (28.8%) | 17(20%) | | |
| **T2DM complications** | | | | |
| Retinopathy | 63 (22.1%) | 10 (11.8%) | 4.421 | **0.036*[a]** |
| Nephropathy | 76 (26.7%) | 10 (11.8%) | 8.150 | **0.004*[a]** |
| Peripheral neuropathy | 105 (36.8%) | 20 (23.5%) | 5.187 | **0.023*[a]** |
| Autonomic neuropathy | 29 (10.2%) | 2 (2.4%) | 5.219 | **0.022***[a] |
| CVD | 50 (17.5%) | 8 (9.4%) | 3.276 | 0.07[a] |
| **Body mass index** | | | | |
| Normal weight | 5 (1.8%) | 0 (0.0%) | 1.289 | 0.517[b] |
| Overweight | 80 (28.1%) | 27 (31.8%) | | |
| Obese | 200 (70.2%) | 58 (68.2%) | | |
| **Comorbidities** | | | | |
| Hypertension | 145 (50.9%) | 23 (27.1%) | 14.984 | **<0.001*[a]** |
| Dyslipidemia | 110 (38.6%) | 11 (12.9%) | 19.581 | **<0.001*[a]** |
| Psychiatric disorder | 21 (7.4%) | 0 (0.0%) | 5.335 | **0.006*[b]** |
| **Antidiabetic medications** | | | | |
| Oral hypoglycemic agents | 187 (65.6%) | 60 (70.6%) | 0.765 | 0.682[a] |
| Insulin | 41 (14.4%) | 11 (12.9%) | | |
| OHG plus Insulin | 57 (20.0%) | 14 (16.5%) | | |
| **Medications other than T2DM drugs** | | | | |
| Absent | 83 (29.1%) | 44 (51.8%) | 14.890 | **<0.001*[a]** |
| Present | 202 (70.9%) | 41 (48.2%) | | |
| **Family History of T2DM** | | | | |
| Absent | 105 (36.8%) | 33 (38.8%) | 0.110 | 0.740[a] |
| Present | 180 (63.2%) | 52 (61.2%) | | |
| **Glycemic control** | | | | |
| Noncontrolled | 191 (67.0%) | 60 (70.6%) | 0.383 | 0.536[a] |
| Controlled | 94 (33.0%) | 25 (29.4%) | | |

*p is significant at the level <0.05, a. chi-square test, b. Fisher exact test
*Type 2 diabetes mellitus (T2DM)

Optimal medication adherence was significantly associated with lower or absent depressive symptoms and little or no diabetes distress. About (91.8%) and (78.8%) of the participants, who had optimal medication adherence, had neither depressive symptoms nor DD, respectively (Table 5).

**Table 5.** Association of medication adherence with depressive symptoms and diabetes distress among study patients (n=370)

| Variable | | Optimal medication adherence | | Test value | P value |
|---|---|---|---|---|---|
| | | Absent | Present | | |
| **Depression** | Absent | 187 (65.6%) | 78 (91.8%) | 22.029 | **<0.001*** |
| | Present | 98 (34.47%) | 7 (8.2%) | | |
| **Diabetes Distress** | Little or no distress | 172 (60.4%) | 67 (78.8%) | 9.769 | **0.002*** |
| | Moderate or high distress | 113 (39.6%) | 18 (21.2%) | | |
| *p is significant at the level <0.05, Chi-square test was used | | | | | |

Medication adherence had a negative moderate correlation with the PHQ-9 total score (r=-0.508), and the DDS total score (r=-0.455). HbA1c had positive weak correlations with DD (r=0.322), and depressive symptoms (r=0.243) (Table 6).

**Table 6. Correlation of diabetes distress and depressive symptoms with medication adherence and HbA1c among the study participants (n=370)**

| Variables | GMAT total score | | HbA1c | |
|---|---|---|---|---|
| | Correlation Coefficient | P-value | Correlation Coefficient | P-value |
| **DDS total score** | -0.455 | <0.001* | 0.322 | <0.001* |
| Emotional burden score | -0.410 | <0.001* | 0.141 | 0.007* |
| Physician related score | -0.378 | <0.001* | 0.293 | <0.001* |
| Regimen related score | -0.351 | <0.001* | 0.312 | <0.001* |
| Interpersonal relationship score | -0.335 | <0.001* | 0.300 | <0.001* |
| **PHQ total score** | -0.508 | <0.001* | 0.243 | <0.001* |
| *p is significant at the level <0.05 | | | | |

Multiple logistic analysis revealed that the predictors of optimal medication adherence were female gender (OR 2.470), sufficient income (OR 4.703), absent dyslipidemia (OR 0.273), and absent depression symptoms (OR 0.197) (Table 7).

**Table 7. Logistic regression analysis for predicting medication adherence in study participants (n=370)**

| Predictors | B | SE | P value | OR | 95% CI | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| **Age** | -0.373 | 0.413 | 0.367 | 0.902 | 0.307 | 1.548 |
| **Gender** | 0.904 | 0.364 | **0.013*** | 2.470 | 1.211 | 5.041 |
| **Education** | | | | | | |
| Primary to secondary education | -0.169 | 0.465 | 0.717 | 0.845 | 0.340 | 2.101 |
| University or above | 0.537 | 0.506 | 0.289 | 1.711 | 0.634 | 4.616 |
| **Occupation** | | | | | | |
| Manual work | -1.732 | 1.102 | 0.116 | 0.117 | 0.020 | 1.535 |
| Trades, semi-professional and professional | -0.355 | 0.418 | 0.397 | 0.702 | 0.309 | 1.593 |
| **Income** | 1.548 | 0.370 | **<0.001*** | 4.703 | 2.276 | 9.718 |
| **Retinopathy** | -0.122 | 0.501 | 0.808 | 0.885 | 0.331 | 2.365 |
| **Nephropathy** | -0.035 | 0.498 | 0.943 | 0.965 | 0.364 | 2.559 |
| **Peripheral neuropathy** | 0.247 | 0.402 | 0.538 | 1.281 | 0.583 | 2.814 |
| **Autonomic neuropathy** | -1.020 | 0.843 | 0.226 | 0.361 | 0.069 | 1.883 |
| **Hypertension** | -0.576 | 0.441 | 0.192 | 0.562 | 0.237 | 1.335 |
| **Dyslipidemia** | -1.299 | 0.425 | **0.002*** | 0.273 | 0.119 | 0.628 |
| **Medications other than antidiabetic drugs** | 0.078 | 0.426 | 0.855 | 1.081 | 0.469 | 2.490 |
| **Depressive symptoms** | -1.624 | 0.542 | **0.003*** | 0.197 | 0.068 | 0.571 |
| **Diabetes distress** | -0.014 | 0.414 | 0.972 | 0.986 | 0.438 | 2.219 |

SE: Standard error, OR: Odds ratio, CI: Confidence interval, *p is significant at the level <0.05.
Binary logistic regression model: Omnibus Tests for Model fit (P<0.001), Hosmer and Lemeshow $X^2$(df)=8, p=0.007, Nagelkerke R Square=0.409; Over all correct classification =83.2%, Dependent Variable (Medication adherence); Reference categories for categorical variables were age ≤ 65 years old, male gender, less than primary education, housewives or not working, insufficient income, absent retinopathy, nephropathy, peripheral neuropathy, autonomic neuropathy, absent hypertension and dyslipidemia, medications other than antidiabetic drugs-, absent depressive symptoms and diabetes distress.

Multiple logistic analysis revealed that the predictors of depressive symptoms were lower level of education (OR=0.243), combined oral hypoglycemic drugs and insulin (OR=2.685), moderate or severe DD (OR=12.554), and suboptimal medication adherence (OR=0.286) (Table 8).

**Table 8. Logistic regression analysis for predicting depression in study participants (n= 370)**

| **Predictors** | **B** | **SE** | **P value** | **OR** | **95%CI** | |
|---|---|---|---|---|---|---|
| | | | | | **Lower** | **Upper** |
| **Marital status** | -0.408 | 0.386 | 0.289 | 0.665 | 0.321 | 1.415 |
| **Education** | | | | | | |
| Primary to secondary education | -1.413 | 0.406 | **<0.001*** | 0.243 | 0.110 | 0.539 |
| University or above | -2.000 | 0.584 | **0.001*** | 0.135 | 0.043 | 0.425 |
| **Occupation** | | | | | | |
| Manual work | -1.087 | 0.620 | 0.081 | 0.337 | 0.100 | 1.141 |
| Trades, semiprofessional, and professional work | 0.068 | 0.452 | 0.881 | 1.070 | 0.441 | 2.595 |
| **Smoking** | | | | | | |
| Absent | 0.686 | 0.546 | 0.209 | 1.986 | 0.681 | 5.789 |
| Present | 0.982 | 0.720 | 0.173 | 2.670 | 0.651 | 10.945 |
| **Income (**sufficient**)** | -0.133 | 0.411 | 0.746 | 0.875 | 0.391 | 1.961 |
| **Exercise** | -0.186 | 0.417 | 0.655 | 0.830 | 0.367 | 1.879 |
| **DM duration** | | | | | | |
| 6-10 years | 0.697 | 0.428 | 0.103 | 2.007 | 0.868 | 4.640 |
| > 10 years | 0.675 | 0.514 | 0.189 | 1.964 | 0.717 | 5.376 |
| **Retinopathy** | -0.043 | 0.454 | 0.924 | 0.957 | 0.393 | 2.332 |
| **Nephropathy** | 0.556 | 0.419 | 0.184 | 1.744 | 0.768 | 3.963 |
| **Peripheral neuropathy** | 0.036 | 0.436 | 0.934 | 1.037 | 0.441 | 2.437 |
| **Autonomic neuropathy** | 0.333 | 0.583 | 0.568 | 1.395 | 0.445 | 4.372 |
| **CVD** | 0.621 | 0.474 | 0.191 | 1.861 | 0.734 | 4.714 |
| **Hypertension** | -0.257 | 0.394 | 0.514 | 0.773 | 0.357 | 1.674 |
| **Psychiatric disease** | 0.916 | 0.668 | 0.170 | 2.449 | 0.675 | 9.249 |
| **Glycemic control** | -0.017 | 0.415 | 0.967 | 0.983 | 0.436 | 2.217 |
| **Antidiabetic treatment** | | | | | | |
| Insulin | 0.561 | 0.527 | 0.287 | 1.753 | 0.624 | 4.923 |
| Oral hypoglycemic plus insulin | 0.988 | 0.449 | **0.028*** | 2.685 | 1.113 | 6.478 |
| **Diabetes distress** | 2.529 | 0.379 | **<0.001*** | 12.554 | 5.966 | 26.373 |
| **Medication adherence** | -1.253 | 0.505 | **0.013*** | 0.286 | 0.106 | 0.768 |

SE: Standard error, OR: Odds ratio, CI: Confidence interval, *p is significant at the level <0.05

Binary logistic regression model: Omnibus Tests for Model fit (P<0.001), Hosmer and Lemeshow $X^2$(df)=8, p=0.083, Nagelkerke R Square=0.578; Over all correct classification =84.6%

Dependent Variable (Depressive symptoms), Reference categories for categorical variables were not married, less than primary school educated, not working or housewife, insufficient income, absent exercise, DM duration < 5 years, absent retinopathy, nephropathy, peripheral neuropathy, autonomic neuropathy and cardiovascular disease (CVD), absent hypertension and psychiatric disease, noncontrolled glycemic control, oral hypoglycemic drugs, absent diabetes distress, and optimal medication adherence.

Multiple logistic analysis revealed that the predictors of DD were less than 65 years old (OR=0.164, P=<0.001), present retinopathy (OR=2.652), present hypertension (OR=2.303), absent family history (OR=0.420), and present depressive symptoms (OR=10.243) (Table 9).

**Table 9.** Logistic regression analysis for predicting diabetes distress in study participants (n= 370)

| Predictors | B | SE | P value | OR | 95%CI | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| **Age (≥ 65 years)** | -1.806 | 0.414 | **<0.001*** | 0.164 | 0.073 | 0.370 |
| **Marital status (married)** | -0.481 | 0.360 | 0.181 | 0.618 | 0.305 | 1.251 |
| **Primary to secondary education** | 0.130 | 0.407 | 0.750 | 1.138 | 0.513 | 2.527 |
| **University or above** | -0.154 | 0.514 | 0.764 | 0.857 | 0.313 | 2.349 |
| **Income(sufficient)** | -0.051 | 0.374 | 0.891 | 0.950 | 0.457 | 1.977 |
| **Exercise(yes)** | -0.481 | 0.369 | 0.192 | 0.618 | 0.300 | 1.274 |
| **Retinopathy** | 0.975 | 0.452 | **0.031*** | 2.652 | 1.093 | 6.436 |
| **Nephropathy** | 0.139 | 0.439 | 0.751 | 1.149 | 0.486 | 2.716 |
| **Peripheral neuropathy** | 0.377 | 0.404 | 0.351 | 1.459 | 0.660 | 3.223 |
| **Autonomic neuropathy** | 1.161 | 0.603 | 0.054 | 3.193 | 0.980 | 10.406 |
| **CVD** | 0.074 | 0.465 | 0.873 | 1.077 | 0.432 | 2.682 |
| **Hypertension** | 0.834 | 0.377 | **0.027*** | 2.303 | 1.099 | 4.826 |
| **Psychiatric disease** | 0.305 | 0.733 | 0.678 | 1.356 | 0.322 | 5.708 |
| **Insulin** | -0.556 | 0.474 | 0.241 | 0.574 | 0.227 | 1.451 |
| **OHD plus insulin** | 0.114 | 0.402 | 0.776 | 1.121 | 0.510 | 2.464 |
| **Family history of T2DM** | -0.867 | 0.324 | **0.007*** | 0.420 | 0.223 | 0.792 |
| **Glycemic control** | -0.643 | 0.373 | 0.084 | 0.526 | 0.253 | 1.091 |
| **Optimal medication adherence** | -0.100 | 0.398 | 0.802 | 0.905 | 0.415 | 1.976 |
| **Depressive symptoms** | 2.327 | 0.380 | **<0.001*** | 10.243 | 4.865 | 21.566 |

SE: Standard error, OR: Odds ratio, CI: Confidence interval, *p is significant at the level <0.05

Binary logistic regression model: Omnibus Tests for Model fit (P<0.001), Hosmer and Lemeshow $X^2$(df)=8, p=0.198 Nagelkerke R Square=0.551; Overall correct classification =85.1%

Dependent Variable (Diabetes distress);

Reference categories for categorical variables were age <65 years, marital status not married, less than primary education, insufficient income, absent exercise, absent retinopathy, nephropathy, peripheral neuropathy, autonomic neuropathy, CVD, absent family history, non-controlled glycemic control, OHDs, absent optimal medication adherence and depressive symptoms

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## DISCUSSION

The purpose of this research was to evaluate the relationship between medication adherence and DD and depressed symptoms in PHC patients with type 2 diabetes in the governorate of Port Said. According to the present investigation, inadequate medication adherence was linked to pre-existing depressed symptoms. Furthermore, although poor medication adherence is not statistically significant, the occurrence of DD has therapeutic importance.

Regarding medication adherence prevalence, 23% of patients in this research demonstrated optimum medication adherence, which is similar to the percentages obtained in studies by **Al-Ozairi *et al.*** [17] in Kuwait, and **Al-Haj Mohd *et al.*** [18] in PHC in Dubai.

In contrast to the current research, the prevalence was lower (17.6%) in the Indonesian study by **Darmada *et al.*** [19]. Variations in lifestyle, different policies and strategies in different countries, disparities in awareness of the significance of medication adherence, different measurement tools, and reliance on patient self-reporting—which can result in an overestimation or underestimation of adherence levels—can all contribute to differences in adherence prevalence [17-19].

In line with research by **Farhat *et al.*** [20] in Lebanon and **Al-Qerem *et al.*** [21] in Jordan, the current study discovered that female patients often take their antidiabetic drugs more consistently than male patients. Gender disparities in social support networks, attitudes toward medicine, and health-seeking behaviors are all potential contributing variables [20,21]. However, a research conducted in Sohag, Egypt, revealed no significant gender-based connection with medication adherence [22].

In line with findings from a study in Cambodia, the current study also suggests that having a sufficient income is a predictor of optimal medication adherence [5].

During univariate analysis, the current research first discovered a strong correlation between DD and medication adherence. Multivariate analysis, however, eliminated the relevance of this connection. While they did not do multivariate analysis, **Fayed *et al.*** [23] in Saudi Arabia and **Rahimi *et al.*** [24] in Iran also found a somewhat unfavorable correlation between DD and adherence to antidiabetic treatment during univariate analysis. The differences in patient cultures and the evaluation instruments used might be the cause of these results' disparities. For example, the GMAT scale was

used in one research, but the Medication MMA scale was used in another.

This research indicated a substantial negative correlation between medication adherence and depressed symptoms, which is in line with results from earlier studies [25,26]. This correlation implies that people with depressed symptoms are more likely than those without depressive symptoms to have trouble sticking to their medication schedule. Depressive disorders may impact a person's motivation, memory, and ability to follow regular routines, all of which might make it harder to take prescription drugs as directed [25,26].

Using univariant analysis, the current study demonstrated a significant relationship between DD and medication adherence; however, multivariate analysis revealed no significant relationship, which is in line with studies **by Rahimi *et al.*** [24] in Iran and **Fayed et al.** [23] in Saudi Arabia. Nonetheless, **Zhang *et al.*** [27] in Singapore showed that DD was a predictor of less than ideal drug adherence. Additionally, in Ghana, **Kretchy *et al.*** [28] proposed that DD was a key factor of drug adherence. The cultural variations of the research group and the use of various instruments for measuring medication adherence might be the cause of the disparities between these studies [24,28].

According to the present research, medication adherence was predicted by depressed symptoms. This result is consistent with earlier research. **Luo *et al.*'s** [29] research in China, however, found no correlation between depression and medication adherence. A number of variables, including as variations in sample demographics, sample size, geographic areas, and the threshold used to define DD, may be responsible for these disparities in prevalence rates [29].

Approximately 84% of the patients in this research had emotional DD, making it the most common subtype there. This result is in line with other studies that found emotional DD to be the most common subtype. In particular, a prevalence rate of 40.8% was recorded by **Fayed *et al.*** [23], 78.7% by **Kamrul-Hassan *et al.*** [30] in Bangladesh, and 43.6% by **Geleta *et al.*** [26] in Ethiopia.

These studies' high incidence of emotional DD indicates that people with diabetes are really concerned about it. Feelings of worry, anxiety, melancholy, and frustration associated with having diabetes are all included in emotional DD. Since emotional DD may have a substantial influence on people's quality of life and adherence to treatment plans, it is essential to understand and address it for complete diabetes care [26,30].

In line with **Fayed *et al.*** [23] in Saudi Arabia, the current study showed that patients under 65 years old had a higher likelihood of developing DD. This finding may be explained by the fact that younger patients with type 2 diabetes face more difficulties because they have less illness experience, financial strains, work demands, and family obligations. It may make managing their illness more difficult. Increased stress reactions may result from their perception of their disease as a danger, especially if they feel they should be well and able to perform their caregiving responsibilities [23].

Variables including gender, marital status, employment, and kind of therapy did not significantly correlate with DD, according to the present research. These findings are consistent with a prior research conducted in Ethiopia by **Geleta *et al.*,** suggesting that these characteristics do not seem to be significantly associated with the risk or severity of DD [26].

Twenty-eight percent of the participants in this research had depressive symptoms, which is in line with findings from a number of other studies conducted in Saudi Arabia, Ethiopia, India, and Spain. Notably, studies conducted in the United Arab Emirates by **Alajmani *et al.*,** [31] Egypt by **Sayed Ahmad *et al.*** [32] reported lower prevalence rates than this study.

A significant negative association between education level and depressed symptoms was found in this research, indicating that those with higher education levels would have less depressive symptoms. Compared to those with lesser educational attainment, they may have greater access to resources, be more health literate, and have better self-management abilities. This finding is consistent with **Bruce *et al.*** [33] in Australia. These findings may differ because of the age of the patients, as the majority were pensioners or had elementary studies. Therefore, conducting age-stratified research seems to be required [33].

According to the current research, poor medication adherence is a predictor of depression symptoms. This outcome is consistent with research done in Vietnam by **Tran *et al.*** [34]. Poor adherence may worsen medical problems, leading to stress and shame, making patients feel powerless, and hurting relationships, which might account for this result. These elements play a part in emotional suffering. Enhancing adherence reduces emotional worries in addition to improving physical health [34]. However, **Luo *et al*.** [29] in China showed that medication adherence and depressed symptoms are not significantly related.

Several demographic and health-related characteristics, including gender, marital status, employment, family history of diabetes, cardiovascular disease, hypertension, exercise habits, and length of diabetes, were not found to be significantly associated with depressed symptoms, according to the present research. This is in line with research conducted in Saudi Arabia by **AbuHegazy *et al.*** [35], which indicates that these characteristics are not very important in determining the probability that people with diabetes would have depressive symptoms. These results highlight the necessity for thorough

evaluations and specialized therapies that take into account variables other than demographic and health-related traits, which has implications for our understanding and treatment of depression in diabetic populations [35] .

Due to the cross-sectional research design, we are unable to show a causal association between DD and depression symptoms and T2DM patients' adherence to their treatment. Because it uses a convenient sample approach and only reflects metropolitan regions and PHC settings, it cannot be extrapolated to the whole Egyptian population.

## CONCLUSION

Patients with type 2 diabetes who get treatment in family practice settings often have suboptimal drug adherence. Suboptimal medication adherence is significantly correlated with the prevalence of depressed symptoms. Suboptimal medication adherence and the occurrence of DD were clinically significant, although they were not statistically significant. These results demonstrate how crucial it is to treat medication adherence in diabetics, especially in those who are depressed, in order to improve their general health outcomes.

### Competing interests

The authors declare that they have no competing interests.

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