Factors Associated with Depression among Type 2 Diabetes Mellitus Patients at a Tertiary Hospital during the COVID-19 Pandemic

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Abstract

Diabetes mellitus is a metabolic disorder characterized by chronic hyperglycemia that can cause various complications, economic burdens, and psychosocial issues that eventually lead to depression. This study aimed to describe the prevalence of depression among type 2 diabetes mellitus patients in the Internal Medicine Outpatient Clinic of a South Jakarta tertiary hospital during the COVID-19 pandemic. This cross-sectional study was conducted from May to July 2021. The data were collected consecutively from 100 patients aged 18 years or older who came for regular consultation. The instrument used for determining depression is Beck Depression Inventory-II. The prevalence of depression, a correlation between depression and participant's characteristics, and multivariate analysis for risk factors were determined. The results showed that the prevalence of mild to severe depression based on the BDI-II classification was 17%. Screening showed mild to severe depression predominantly in females above 60 years old, with higher levels of education, obesity grade I, individuals with one or more comorbidities, and those who had diabetes for more than ten years. In this study, having one or more comorbidities was associated with an increased risk of depression in people with diabetes.

Keywords: Beck Depression Inventory-II, depression screening, diabetes mellitus, prevalence of depression

Introduction

Noncommunicable Diseases (NCDs) are by far the leading causes of death globally. According to global trends, the World Health Organization (WHO), stated that NCDs contributed to 71% (41 million) of 57 million deaths that occurred globally in 2016.[1] NCDs include cardiovascular disease, cancer, chronic respiratory disease, and diabetes. Based on WHO data in 2020, Indonesia, with an estimated population of 261,100,000, has a 1,365,000 total death rate caused by NCDs or approximately 73%, with diabetes as one of the etiologies.[2]

In 2019, according to International Diabetes Federation (IDF), 463 million adults aged 20–79 years old worldwide had diabetes, with about 79.4% sufferers living in low and middle-income countries. Of that 463 million adults, 240.1 million (9.6%) are male, and 222.9 million (9.0%) are female. In 2019, IDF estimated that there would be 578.4 million diabetes patients in 2030. The total number will increase to 700.2 million in 2045.[3] The 2018 National Basic Health Research/*Riset Kesehatan Dasar* (Riskesdas) documented diabetes prevalence based on doctor's diagnosis in the population older than 15 years old is 2%. The highest prevalence of diabetes mellitus (DM) based on a doctor's diagnosis and more than 15 years old is in Jakarta, with a total percentage of 3.4%.[4]

Diabetes creates economic and health burdens and poses various psychosocial issues to people with diabetes (PWD), such as depression.[1,3,5] As the most common mental disorder, depression commonly affects PWD. It has a bidirectional relationship: diabetes increases the risk of future depression, and depression increases the risk of having diabetes.[5] Patients with diabetes need a comprehensive self-management plan (monitoring blood glucose, daily oral antidiabetic drugs and/or insulin injection, and committing to a healthy lifestyle, including a nutritional diet and physical activity).[3] Because of those things, they may have difficulties of accepting and adjusting a comprehensive self-management plan to different levels, which will pose a practical and psychological burden. In addition to psychological mechanisms, biological mechanisms, such as inflammation, may have a role in the relationship between depression and diabetes.[5]

In 2017, WHO estimated 4.4% of the world's population suffered from depression.[6] While the prevalence of comorbid depression in adults with type 2 diabetes mellitus (T2DM) ranges from 10% to 15%.[7] Based on age predictor, the prevalence of depression heightens in adult-old age (more than 7.5% in women aged 55–74 years old, and more than 5.5% in men).[6] The 2018 Riskesdas documented that for three decades (1990–2017), depression was the first and most significant mental disorder that contributed to the burden of disease in Indonesia.[8]

The current COVID-19 pandemic that occurred globally has become a stressor for many individuals. It has changed people's lifestyles and threatens physical and mental health and well-being.[9] Stressors during this pandemic may arise from fear of transmission, inadequate information, loss of personal control and freedom, changes of plan in a shorter period or the future, concerns about the health and well-being of oneself, relatives, and family, negative stigma against COVID-19 sufferers, the quarantine period, loss of job, and financial insecurity.[9] These circumstances may increase predisposed individuals' risk of psychiatric ailments such as depression and anxiety.[9] Alessi, *et al.*, found a high prevalence of psychological distress among PWD during the COVID-19 pandemic.[10] Another study on T2DM patients treated in Egypt's Primary Health Care during the COVID-19 pandemic showed that 9.2% of the participants had a major depression.[11]

Due to the high prevalence of diabetes, which pose various burdens, and depression is a mental health disorder that often occurs in PWD, diabetes may increase the incidence of depression, especially during the COVID-19 pandemic. Therefore, this study aimed to determine the prevalence of depression among PWD who came for regular consultation in the Internal Medicine Outpatient Clinic of a tertiary hospital in South Jakarta Municipality, the Special Capital Region of Jakarta, Indonesia.

Method

This cross-sectional study was conducted at a tertiary hospital in South Jakarta from May to July 2021. The sample size for a single population was calculated to be a minimum of 80 participants to assess depression among T2DM patients (CI = 95%, Z = 1.96, power = 90%, d = 0.10, p-value = 0.292). A total of 100 participants were eligibly recruited. The inclusion criteria for this study were adults above 18 years old, diagnosed with T2DM, and who agreed to participate in this study. Adult T2DM patients who came for regular consultation at the Internal Medicine Outpatient Clinic consecutively between May and July 2021 were asked whether they agreed to participate in this study. Patients who agreed to participate would undergoing further history taking and review of

their medical records to rule out any existing exclusion criteria.

The exclusion criteria were patients with a cognitive disorder, a severe visual impairment that caused an inability to fill in the questionnaire independently, and record of mental disorder treatment in the past three months of sampling time. All recruited participants agreed to sign a written informed consent before data collection. The data was collected by asking the participants to fill out Beck's Depression Inventory (BDI)-II questionnaire in Indonesian language. The BDI-II is one of the most widely used depression self-rating scales to assess depressive symptoms and their severity.[12,13] It consists of 21 items describing symptoms and categories reflecting over psychological and somatic symptoms of depression. Each item has four answers with a point weight of 0–3. All items are summed to create a total score, with higher scores indicating higher levels of depression.[12,13]

Demographical data (sex, age, education), duration of diabetes (less than 1 year, 1–5 years, 6–10 years, more than 10 years), the type of diabetes medication (without medical regiment, with one/two/three oral antidiabetic regiments, with insulin, with both insulin and oral antidiabetic), and the duration of the medication were obtained from taking and reviewing the patient's medical record. The nutritional status of participants was assessed with body mass index (BMI) and determined based on the WHO cut-off point for Asian-Pacific populations: less than 18.5 for underweight, 18.5–22.9 for normal weight, 23–24.9 for overweight, 25–29.9 for obesity grade I, more than or equal to 30 for obesity grade II. Diabetes was determined based on the patient's medical record and laboratory parameters, such as HbA1C higher than 6.5%, fasting blood glucose higher than 126 mg/dL, or random blood glucose higher than 200 mg/dL in two consecutive measurements.

Based on the patient's medical record, comorbidity was determined by whether there were other chronic conditions, such as hypertension, chronic kidney disease, cardiovascular disease, coronary artery disease, or congestive heart failure. Comorbidities were then classified into two groups: without comorbidity (no additional chronic disease) and the presence of one or more comorbidities. Record of diabetic foot ulcer (DFU) obtained from physical examination and medical records looking for unresolved foot ulcer or records of amputation related to diabetic foot and then classified into two groups: patient with a record of DFU and without a record of DFU. Total scores from the individual BDI-II questionnaire were classified into four groups: minimal (0–13), mild (14–19), moderate (20–28), and severe (29–63).[12,13]

Categorical data describing participants' characteris-

tics (sex, age, education, nutritional status, duration of diabetes, presence of comorbidities, record of DFU, diabetes treatment) and BDI-II score (minimal, mild, moderate, and severe) were presented as frequency and percent. The correlation between depression and respondent characteristics and the correlation between depression and diabetes treatment were also assessed using a bivariate Chi-square test. Statistical significance was determined if a p-value was less than 0.05. If the bivariate analysis found a p-value of less than 0.20, it would proceed to multivariate logistics regression analysis.

Results

During the study period from May to July 2021, 105 individuals with T2DM were consecutively approached to participate. Of 100 participants were subsequently enrolled; none had exclusion criteria and were eligible for the analysis (Figure 1).

Table 1 shows the participants' characteristics. The results showed 61 participants in this study were female, and the largest age group was more than 60. Most subjects had BMI within obesity grade 1 and had been diagnosed with T2DM for more than 10 years. Almost two-thirds of participants attended senior high school or higher (college or university). More than half of the subjects had hypertension as a comorbid (54%), and most had neither record of DFU nor amputation (81%). Most participants received pharmacological treatments with vari-
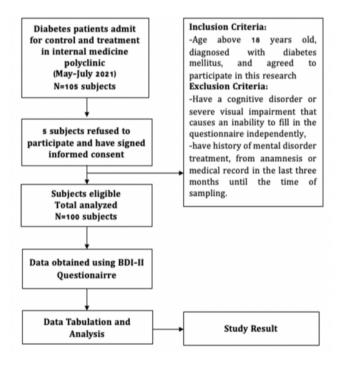
ous regimens. More than a third of them were on a combination of insulin and oral antidiabetics (OAD), followed by only OAD, then only insulin-based treatment. More than two-thirds of the participants had a treatment duration of 1–5 years and more than ten years (31% and 37%, respectively).

The prevalence of depression is presented in Table 2.

Table 1. Participants Characteristics

Variable	Category	n	%
Sex	Male	39	39
	Female	61	61
Age (Year)	18–39	6	6
	40–59	42	42
	60+	52	52
Education	<Senior high school	37	37
	≥Senior high school (University)	63	63
Nutritional status (BMI)	Underweight	4	4
	Normal	25	25
	Overweight	23	23
	Obesity grade I	32	32
	Obesity grade II	16	16
Duration of diabetes	<1 year	4	4
	1–5 years	23	23
	5–10 years	19	19
	10+ years	54	54
Comorbidity	Hypertension	54	54
	CKD	10	10
	CVD	10	12
	CAD	27	30
	CHF	11	11
Record of DFU	DFU	15	15
	Amputation	4	4
	No DFU or amputation	81	81
Type of medical regiment	No medical regiment	5	5
	OAD		42
	One regiment	20	20
	Two regiments	15	15
	Three medications	7	7
	Insulin		18
	Basal	1	1
	Prandial	5	5
	Basal bolus	10	10
	Pre-mixed	2	2
	OAD + Insulin	35	35
Duration of treatment	<1 year	8	8
	1–5 years	31	31
	5–10 years	24	24
	10+ years	37	37

Notes: BMI = Body Mass Index, CKD = Chronic Kidney Disease, CVD = Cardiovascular Disease, CAD = Coronary Artery Disease, CHF = Congestive Heart Failure, DFU = Diabetic Foot Ulcer, OAD = Oral Antidiabetic Drug

Figure 1. Diagram Depicting Participants and Study Flow

Table 2. The Prevalence of Depression Based on Beck Depression Inventory-II

Depression	BDI-II Score	n	%
Minimal	0–13	83	83
Mild	14–19	8	8
Moderate	20–28	7	7
Severe	29–63	2	2

Note: BDI-II = Beck Depression Inventory-Second Edition

Table 3. Correlation between Depression and Respondent Characteristics

Variable	Category	Mild to Severe Depression	Minimal Depression	p-value
		n = 17 (17%)	n = 83 (83%)	
Sex	Male	7 (41.18)	32 (38.55)	0.840
	Female	10 (58.82)	51 (61.45)	
Age (year)	18–39	0 (0)	6 (7.23)	0.507
	40–59	8 (47.06)	34 (40.96)	
	60+	9 (52.94)	43 (51.81)	
Education	<Senior high school	8 (47.06)	29 (34.94)	0.346
	≥Senior high school (University)	9 (52.94)	54 (65.06)	
Nutritional status	Underweight	0 (0)	4 (4.82)	0.526
	Normal	2 (11.76)	23 (27.71)	
	Overweight	5 (29.41)	18 (21.69)	
	Obesity grade I	7 (41.18)	25 (30.12)	
	Obesity grade II	3 (17.65)	13 (15.66)	
Duration of diabetes	<1 year	2 (11.76)	2 (2.41)	0.135
	1–5 years	2 (11.76)	21 (25.3)	
	5–10 years	5 (29.41)	14 (16.87)	
	10+ years	8 (47.06)	46 (55.42)	
Comorbidity	No comorbid	1 (5.88)	28 (33.73)	0.036*
	One comorbid	8 (47.06)	31 (37.35)	
	Two comorbidities	7 (41.18)	14 (16.87)	
	Three or more comorbidities	1 (5.88)	10 (12.05)	
History of DFU	No DFU	14 (82.35)	67 (80.72)	0.848
	DFU	2 (11.76)	13 (15.66)	
	Amputation	1 (5.88)	3 (3.61)	
Type of medical regimen	No medical regiment	1 (5.88)	4 (4.82)	0.963
	Oral antidiabetic			
	One regimen	2 (11.76)	18 (21.69)	
	Two regimens	2 (11.76)	13 (15.66)	
	Three regimens	1 (5.88)	6 (7.23)	
	Insulin			
	Basal	0 (0)	1 (1.20)	
	Prandial	1 (5.88)	4 (4.82)	
	Basal bolus	2 (11.76)	8 (9.64)	
	Mixed	0 (0)	2 (2.41)	
	OAD + insulin	8 (47.06)	27 (32.53)	
Duration of Treatment	<1 year	3 (17.65)	5 (6.02)	0.281
	1–5 years	3 (17.65)	28 (33.73)	
	5–10 years	5 (29.41)	19 (22.89)	
	10+ years	6 (35.29)	31 (37.35)	

Notes: DFU = Diabetic Foot Ulcer, OAD = Oral Antidiabetic Drug

The screening conducted using the BDI-II instrument found that most participants scored 0–13 and were considered to have minimal depression. While, another 17% scored equal to or more than 14, classified as having mild to severe depression. Based on the BDI-II classification, 83% of participants had minimal depression, 8% mild depression, 7% moderate depression, and 2% severe depression, as shown in Table 2.

The correlation analysis between several variables and depression is presented in Table 3. From bivariate analysis, comorbidity correlated statistically with depression (p-value<0.036). While, other variables such as sex, age, education, nutritional status, duration of diabetes, and record of DFU were not statistically significant. No correlation was found significant for types of diabetes treatment or duration of treatment. Multivariate analysis in Table 4 showed factors associated with depression in

T2DM patients with one or more comorbidities was eight times more likely to experience depression than those with none (adjusted PR of 8.09; 95% CI = 1.01–65.12).

Discussion

In this study, the prevalence of depression in DM patients during the COVID-19 pandemic was 17%. This data was higher than the prevalence of depression globally, as stated in 2017 WHO data (4.4%),[6] and 27 European countries collected data of 2013–2015 (6.38%).[14] While the prevalence of depression among PWD in general ranges from 10–15%.[15] These suggested that depression was more prevalent among DM patients compared to the general population. The current COVID-19 might also increase predisposed individuals' risk of psychiatric ailments. A survey by Ettman, *et al.*,[9] stated that the prevalence of depression (mild-severe) in-

Table 4. Multivariate Analysis Factors Associated with Depression in People with Diabetes

Variable	Category	Crude PR (95%CI)	Adjusted PR (95% CI)
Sex	Male	1.09 (0.42–2.88)	1.74 (0.61–4.95)
	Female	1.00	1.00
Age (year)	60+	01.04 (0.40–2.69)	1.13 (0.41–3.10)
	<60 years old	1.00	1.00
Education	≥Senior high school (University)	0.66 (0.26–1.71)	0.72 (0.25–2.06)
	<Senior high school	1.00	1.00
Nutritional status	Obesity	1.55 (0.59–4.07)	1.60 (0.58–4.41)
	No obesity	1.00	1.00
Duration of diabetes	10+ years	0.76 (0.29–1.96)	0.72 (0.14–3.74)
	<10 years	1.00	1.00
Comorbidity	1 comorbid+	6.53 (0.87–49.28)	8.09 (1.01–65.12)*
	No comorbid	1.00	1.00
History of DFU	Yes	0.91 (0.26–3.18)	1.36 (0.34–5.46)
	No	1.00	1.00
Type of medical regiment	Insulin	1.56 (0.58–4.21)	1.83 (0.63–5.36)
	Not Insulin	1.00	1.00
Duration of medication	10+ years	0.93 (0.34–2.51)	1.21 (0.23–6.41)
	<10 years	1.00	1.00

Notes: PR = Prevalence Ratio, DFU = Diabetic Foot Ulcer, CI = Confidence Interval
*Result of correlation test was expressed through measurement of prevalence ratio. People with diabetes who had >1 comorbid were at eight times greater risk for depression.

creased three times higher, from 8.5% before the COVID-19 pandemic to 27.8% during the COVID-19 pandemic. It is important to note that the COVID-19 pandemic may impact PWD. Care should be taken to detect early signs of depression in PWD.

Findings in this study revealed that women were highly likely to suffer from depression, with a percentage of 61%. Torre, *et al.*,[14] explained that in 27 European countries, the prevalence of depression in women was 7.74% and lowered in men, with a percentage of 4.89%. The study by Alonso-Moran, *et al.*,[15] in Spain reported that 9.8% of patients diagnosed with depression consist of 15.1% in women and 5.2% in men. These findings may indicate that women are more prone to depression than men and paying attention if there is depressive behavior in women might be necessary.

Another participants characteristic in this study showed that the biggest age group who experienced depression was older than 60 years. This result was similar to WHO data which reports that the prevalence of depression culminates in adult-old age (above 7.5% in women aged 55–74 years old and above 5.5% in men).[6] Older adults, in general, already have underlying conditions that are risk factors for depression. Those conditions are functional and cognitive impairment, comorbid medical conditions, social isolation, and widowed or separated marital status.[16] Diabetes could be one of the comorbid conditions in the elderly. In addition, social isolation during the COVID-19 pandemic might aggravate the risk of depression. The look Action for Health in Diabetes (AHEAD) study found that the prevalence of mild or greater de-

pressive symptoms in older adults (mean [SD] age 75.6 [6.0] years) with diabetes was more than 1.6 times higher during COVID-19 than before the pandemic.[17]

Obesity in diabetes can escalate the risk of depression. Other findings in this study showed that most respondents, through measurement of BMI, have obesity grade 1. This result was similar to a meta-analysis study by Chauvet-Gelinier, *et al.*,[18] stated that obesity increases the risk of future depression (unadjusted OR = 1.55; 95% CI = 1.22-1.98; p-value<0.001). The underlying mechanism is the increase of adiponectin and accumulating adipose tissues that stimulate inflammatory cytokines, which can increase neuroinflammation and depressive behavior, endothelial dysfunction, and oxidative stress.[18] Obesity and depression in PWD are associated with hormonal dysregulation, including the hypothalamic-pituitary-adrenal (HPA) axis, cortisol, leptin, adiponectin, resistin, and insulin.[5,18] Those disruptions might lead to insulin resistance and depression.[18]

The Diabetes in Adolescence Engagement and Monitoring by Pharmacists (DIADEMA) study conducted by Salinero-Fort, *et al.*,[19] in Spain reported that insulin and oral antidiabetic are significantly related to depression (OR = 1.802; p-value≤0.001). Two points elucidate these conditions. First, frequent glucose measurements and insulin injections induce pain, distress, and depression. Second, insulin is commonly used in poor glycemic control, and non-optimal diabetes control leads to worse moods and tremendous stress.[20] Those conditions might elucidate the high prevalence of depression found in this study since more than a third of participants

(35%) were treated with a combination of oral antidiabetic and insulin.

This study found a more significant prevalence of mild to severe depression in T2DM patients diagnosed for at least five years or longer. This result was consistent with the study by Darwish, *et al.*,[21] showed that the duration of diabetes affects the development of depressive symptoms. In general, depressive symptoms immediately increase after people are diagnosed with diabetes, decrease over several years, and increase within a longer duration. Depression coincides with longer diabetes duration and has been proven to increase frailty score and cerebral macrovascular complications.[21] All those things contribute to depressive symptoms, for instance, anhedonia and apathy. It is necessary to be aware of these complaints in patients with a long record of diabetes.

A study by Ahmad, *et al.*,[22] reported that DFU patients are more likely to undergoing depression and anxiety. The likelihood of patients who have DFU for more than 7 months to suffer depression is 12.62-fold higher than less than 7 months (p-value = 0.001 95% CI = 1.48–4.67).[22] It was sensible that DFU disrupted a patient's daily life. These included changes in sleep patterns, impaired mobility, and disturbances in certain aspects of life, such as feelings of loneliness, helplessness, anxiety, and depression.[22] However, this study could not portray those findings because 81% of respondents had no record of DFU or amputation.

Although this study showed a higher prevalence of women in the mild to severe depression group, no significant correlation between participants' sex and depression was observed in this study. Demmer, *et al.*,[23] reported that depressive symptoms were associated with an increased risk of diabetes, particularly in women. This was proven by the risk ratio (RR) of depressive symptoms between men and women, which was 0.69 [0.43–1.10] and 2.11 [1.06–4.19], with a p-value of <0.007. It proved that men and women represented different ways of dealing with stress and adversity, which might contribute to different diabetes profiles. Men tend to be aggressive and engage in activities, while women are likely to think a lot, reduce physical activity, and eat more. In addition, women tend to have an exaggerated inflammatory response to chronic stress. Demmer, *et al.*,[23] reported that women with depressive symptoms favor consuming sugary and fast food more than fruits and vegetables, leading to increased adipose tissue, insulin resistance, metabolic disturbance, and mood disorder risk.

According to this study, comorbidities were significantly correlated with depression. Comorbidity is the coexistence of one or more additional diseases or disorders occurring concomitantly with a primary disease or disorder, whether noncommunicable, mental, or infectious.[24] The mechanism that could explain this is comorbidities such as hypertension and obesity caused by neurohormonal alteration by leptin. Leptin regulates appetite, stimulates sympathetic nerves, and increases insulin sensitivity, natriuresis, diuresis, and angiogenesis. Leptin normally is secreted to blood circulation in low concentrations.[5,18] However, in obese people, leptin resistance occurs, causing hypertension and depressive symptoms.[18]

This study had its limitation that must be acknowledged. As the hospital where the study took place was a tertiary hospital, most patients admitted already had multiple comorbidities. This situation could exacerbate the condition and lead to a higher prevalence. A single-center study's results might not represent other populations. However, this study might benefit future study as a reference point investigating other associated factors related to depression and diabetes, especially during the COVID-19 pandemic. The potential bias that might arise from self-completion questionnaires in crowded clinic settings run the risk of being biased by respondents' quick and disorganized responses. This condition can be mitigated by assisting in the less crowded area and ensuring the respondents are in their free time.

Conclusion

This study shows that the prevalence of depression among T2DM patients was 17% at a tertiary hospital during the COVID-19 pandemic. Amongst factors associated with depression, having one or more comorbidities is associated with an increased risk of depression in T2DM patients in this study. Due to a substantial proportion of PWD with complication in a tertiary hospital, this finding suggests that screening for depression in PWD is clinically beneficial. Early detection and prompt handling to address psychological ailments in PWD is essential to provide a comprehensive management of diabetes.

Abbreviations

NCDs: Noncommunicable Diseases; WHO: World Health Organization; IDF: International Diabetes Federation; Riskesdas: *Riset Kesehatan Dasar*; DM: Diabetes Mellitus, PWD: People with Diabetes; T2DM: Type 2 Diabetes Mellitus; COVID-19: coronavirus disease 2019; CI: Confidence Interval; BD-II: Beck Depression Inventory-II; BMI: Body Mass Index; DFU: Diabetic Foot Ulcer; CKD: Chronic Kidney Disease; CVD: Cardiovascular Disease; CAD: Coronary Artery Disease; CHF: Congestive Heart Failure; OAD: Oral Antidiabetics; SHS: Senior High School; PR: Prevalence Ratio; AHEAD: Action for Health in Diabetes; SD: Standard Deviation; HPA: Hypothalamic-Pituitary-Adrenal; DIADEMA: Diabetes in Adolescence Engagement and Monitoring by Pharmacists; OR: Odds Ratio; RR: Risk Ratio.

Ethics Approval and Consent to Participate

Ethical approval was obtained from The Ethics Commission of

Fatmawati General Hospital (19/KEP/VI/2021).

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