



Short Communication

Association between depression and HbA1c levels in the elderly population with type 2 diabetes mellitus during COVID-19 pandemic

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Abstract

Diabetes mellitus is a chronic progressive disease affecting the metabolic hormonal system and its prevalence in the elderly population is high. Depression is one of the psychiatric disorders in diabetic patients in particular during the coronavirus disease 2019 (COVID-19) pandemic. People with depression are more susceptible to leading an unhealthy lifestyle; therefore, depression and diabetes have a negative influence on life quality and aggravate complications and symptoms. The aim of this study was to determine the association between depression and hemoglobin A1c (HbA1c) levels in elderly with type 2 diabetes mellitus patients. A cross-sectional study was conducted where a total of 42 diabetic patients from the Puskesmas Belakang Padang, Batam of Indonesia was recruited. The HbA1c level, the main determinant of optimum glycemic control, was measured using ion-exchange high-performance liquid chromatography while the level of depression was assessed using Geriatric Depression Scale-15 (GDS-15). The association between depression and HbA1c levels was analyzed using the chi-squared test. Our study found that that 69% of the elderly with diabetes experienced a depression, classified as mild (40.5%), moderate (21.4%) and severe (7.1%). There were 61.9% of the subjects had poor HbA1c control. Our data suggested that the depression level was associated with HbA1c ($p=0.002$). In conclusion, there is a significant association between depression and HbA1c levels in the elderly with type 2 diabetes mellitus.

Keywords: Diabetes mellitus, depression, GDS-15, geriatric, HbA1c

Introduction

Indonesia has entered an ageing population phase where the population of people aged ≥ 60 years exceeding 7% of the total population and this trend is expected to continue in 2020-2035 as life expectancy rises in the country [1]. Depression among the elderly is a global issue of public health concern. It has a significant impact on the welfare and quality of life of the elderly, increasing in demand for health care services and higher healthcare costs. The prevalence of depression among the elderly ranges from 11 to 16% [2]. Depression and type 2 diabetes mellitus (simply called diabetes in this article) are one of the most common diseases in the elderly. Diabetes is a chronic disease that requires long-term treatment and associates with complications that affect a person's quality of life, in particular in the elderly [3].



It was reported that approximately 30% of people with diabetes have depressive symptoms and 10% have major depression; and people with diabetes have twice the risk of depression compared with individuals without diabetes [4]. The prevalence of depression among diabetes patients is higher than in the general population, with estimates of prevalence between 8 and 27%, approximately three times the rate in the general population [5]. A study shown a greater systematic risk of developing depression in diabetic than non-diabetic patients and people who are depressed tend to be more susceptible to unhealthy lifestyles so that comorbidity such as diabetes can occur and worsen the complications and symptoms [6]. In particular during the coronavirus disease 2019 (COVID-19) pandemic, depression is reported to be high [7-9].

Optimal glycemic control is the main goal of diabetic patients [10]. Glycemic control measured by hemoglobin A1c (HbA1c) is a major determinant of the risk of complications and also diabetes-related mortality rate. A large clinical trials in the UK have shown that long-term intensive glycemic control reduces the risk of macrovascular and microvascular complications [11]. It is recommended that HbA1c level in diabetic patients should be maintained at <8.0% to prevent complications and mortality [12]. The psychological aspects of diabetic patients are still not widely studied. Psychological problems in particular depression in the elderly could worsen diabetes management. Whereas in the elderly, diabetes is a chronic disease, which is suffered for a lifetime and requires social support to maintain their physical health [13]. This study sought to investigate the association between depression and HbA1c levels in the elderly with diabetes mellitus in the primary care setting.

Methods

A cross-sectional study was conducted in between June and October 2020 at the *Puskesmas Belakang Padang*, Batam province of Indonesia. *Puskesmas* is a government-mandated community health clinic located across Indonesia. The population in this study was all elderlies (≥ 60 years of age) with diabetes and included in the *Program Pengelolaan Penyakit Kronis (PROLANIS)* list under supervision of *Puskesmas Belakang Padang*. *PROLANIS* is a health service system and a proactive approach held by *Badan Penyelenggara Jaminan Sosial (BPJS)*, an Indonesia Health Insurance, for people with chronic diseases (such as diabetes and hypertension) to achieve optimal quality of life. The activities included in this program are medical and educational consultation, home visit, therapy reminder, and health status monitoring. A total of 48 diabetic patients were included in this program and a total sampling was adopted in this study.

The sociodemographic data were collected during clinic visits and from patients' medical records at the *Puskesmas*. The data included age, gender, education background, marital status, type of job, types of diabetes drugs and duration of illness. To measure the level of depression, a set of Geriatric Depression Scale (GDS-15) questionnaire [14, 15]. Briefly, the GDS-15 questionnaire consisted of 15 questions and the possible answers were "Yes" and "No". Ten questions suggested the presence of depression when answered as "Yes", while the rest questions indicated the depression when answered as "No". Each answer that indicated the present of depression, a score of one was provided. The total of the scores were classified as normal (score 1-4), mild depression (score 5-8), moderate depression (score 9-11), and severe depression (score 12-15).

The HbA1c level, a marker for monitoring glycemic control, was measured by an ion-exchange high-performance liquid chromatography (HPLC) which has been standardized by National Glycohemoglobin Standardization Program (NGSP). In this study, the levels of HbA1c were classified as good glycemic control if the HbA1c level was <8% and poor glycemic control if >8%. The cut-off point for HbA1c level was higher than 7% as in general population because the subjects included in this study were elderly which had the HbA1c target around 7.5 to 8.5%.

The chi-squared test was used to analyze the association between depression level and the HbA1c level and a $p < 0.05$ was considered significant with a 95% confidence interval. The statistical analysis was conducted using IBM SPSS version 22.

Results

Patients' characteristics

A total of 48 diabetic patients, participated in PROLANIS program, were recruited, of which six patients were excluded because they refused to participate in this study. The characteristics (age, gender, marital status, educational attainment type of job and smoking history) are presented in **Table 1**. Most of the patients (92.5%) aged 60-74 years and 81.0% were females. Majority of the patients (73.8%) were married and more than a third of the patients (35.7%) completed the elementary school (6 years). There were 66.7% patients unemployed or housewives. More than half of patients (54.8%) used a single hypoglycemic agent, while the other 45.2% treated with a combination therapy of sulfonylurea and biguanide. Based on the duration of the disease, 42.9% patients had been diagnosed with diabetes mellitus for more than five years.

The level of depression

The results of the GDS-15 questionnaire indicted that there were 29 respondents (69.0%) had a depression. Mild depression was predominant (40.5%) followed by moderate depression (21.4%) and severe depression (7.1%). The distribution of depression levels based on patients' characteristics are summarized in **Table 1**. Depression affected more women than men (90.0 vs. 62.5%). The married respondents were more likely to experience depression (74.2%) than widows/widowers (50%), with the mild depression was the most commonly occurred (45.2%). Depression among those unemployed or housewives were more common (71.4%) than other types of job.

The level of HbA1c

Glycemic control can be predicted by measuring HbA1c level. In this study, HbA1c more than 8% was considered as poor glycemic control. Our data indicated that more than half of patients (61.9%) had a poor glycemic control (**Table 1**). The level of HbA1c level was not significant different among different types of diabetic drugs. Based on the duration of the disease, poor glycemic control was observed in 80% and 76.9% of patients who had been diagnosed in 6-10 years and >10 years, respectively.

The association between depression and HbA1c level

The association the levels of depression and HbA1c level are presented in **Table 2**. Regardless of depression status, more than half respondent (61.9%) in this study has a poor glycemic control. Among the total of patients with had no depression (n=13), 76% had good HbA1c level and only 23.1% had poor HbA1c level. In contrast, there were 76.5%, 88.9% and 66.7% of those who had mild, moderate and severe depression had poor HbA1c level suggesting that the patients who had depression tend to have poor glycemic control (**Table 2**). The chi-squared test indicated there was a significant association between the level of depression and the HbA1c levels in the elderly with diabetes (p=0.005) (**Table 2**).

Discussion

Depression is not only a major public health problem among the general population, but also has become a great concern, especially in the elderly population. This unrecognized and underdiagnosed mental health disorder is common in the elderly population group. This study sought to assess the association between the depression and the level of HbA1c during the COVID-19 pandemic. HbA1c indicates the blood sugar levels during the last three months, therefore it was chosen as the primary control and benchmark for diabetic patients [16]. Our data suggested that the higher the level of depression, the higher the HbA1c level.

Table 1. Distribution of depression and HbA1c level based on characteristics of diabetic patients (n=42)

| Patients' characteristics | Total | Normal | Depression level | | | HbA1c level | | |
|---------------------------|------------|-----------|------------------|----------|----------|-------------|-----------|-----------|
| | | | Mild | Moderate | Severe | Total | Poor | Good |
| | n (%) | n (%) | n (%) | n (%) | n (%) | n (%) | n (%) | n (%) |
| Total | 42 (100.0) | 13 (31.0) | 17 (40.5) | 9 (21.4) | 3 (7.1) | 29 (69.0) | 26 (61.9) | 16 (38.1) |
| Age group | | | | | | | | |
| 60-74 years | 40 (95.2) | 12 (30.0) | 17 (42.5) | 9 (22.5) | 2 (2.5) | 28 (70.0) | 25 (62.5) | 15 (37.5) |
| 75-90 years | 2 (4.8) | 1 (50.0) | 0 (0.0) | 0 (0.0) | 1 (50.0) | 1 (50.0) | 1 (50.0) | 1 (50.0) |
| Gender | | | | | | | | |
| Male | 8 (19.0) | 3 (37.5) | 3 (37.5) | 0 (0.0) | 2 (25) | 5 (62.5) | 5 (62.5) | 3 (37.5) |
| Female | 34 (81.0) | 10 (29.4) | 14 (41.2) | 9 (26.5) | 1 (2.9) | 24 (90.0) | 21 (61.7) | 13 (38.3) |
| Marital status | | | | | | | | |
| Single | 1 (2.4) | 0 (0.0) | 1 (100.0) | 0 (0.0) | 0 (0.0) | 1 (100.0) | 0 (0.0) | 1 (100.0) |
| Married | 31 (73.8) | 8 (25.8) | 14 (45.2) | 6 (19.4) | 3 (9.7) | 23 (74.2) | 20 (67.7) | 21 (32.3) |
| Widow/widower | 10 (23.8) | 5 (50.0) | 2 (20.0) | 3 (30) | 0 (0.0) | 5 (50.0) | 6 (60.0) | 4 (40.0) |
| Educational attainment | | | | | | | | |
| Never attend the school | 6 (14.3) | 3 (50.0) | 2 (33.3) | 1 (16.6) | 0 (0.0) | 3 (50.0) | 3 (50.0) | 3 (50.0) |
| Elementary school | 15 (35.7) | 5 (33.3) | 5 (33.3) | 4 (26.6) | 1 (6.6) | 10 (66.7) | 12 (80.0) | 3 (20.0) |
| Junior High school | 9 (21.4) | 1 (11.1) | 6 (66.7) | 2 (22.2) | 0 (0.0) | 8 (88.9) | 6 (66.7) | 3 (33.3) |
| Senior High school | 8 (19.0) | 2 (25.0) | 3 (37.5) | 2 (25.0) | 1 (12.5) | 6 (75.0) | 5 (62.5) | 3 (37.5) |
| College | 4 (9.5) | 2 (50.0) | 1 (25.0) | 0 (0.0) | 1 (25.0) | 2 (50.0) | 0 (0.0) | 4 (100.0) |
| Type of job | | | | | | | | |
| Unemployed/housewife | 28 (66.7) | 8 (28.6) | 12 (42.9) | 8 (28.6) | 0 (0.0) | 20 (71.4) | 18 (64.3) | 10 (35.7) |
| Entrepreneur | 6 (14.3) | 2 (33.3) | 3 (50.0) | 1 (16.7) | 0 (0.0) | 4 (66.7) | 5 (83.3) | 1 (16.7) |
| Retired | 8 (19.0) | 3 (37.5) | 2 (25.0) | 0 (0.0) | 3 (37.5) | 5 (62.5) | 3 (37.5) | 5 (62.5) |
| Type of diabetic drug | | | | | | | | |
| Sulfonylureas | 10 (23.8) | 4 (40.0) | 4 (40.0) | 1 (10.0) | 1 (10.0) | 6 (60.0) | 6 (60.0) | 4 (40.0) |
| Biguanide | 13 (31.0) | 6 (46.1) | 5 (83.3) | 2 (33.3) | 0 (0.0) | 7 (53.8) | 8 (61.5) | 5 (38.5) |
| Combination | 19 (45.2) | 3 (15.7) | 8 (42.2) | 6 (31.5) | 2 (10.5) | 16 (84.2) | 12 (63.2) | 7 (36.8) |
| Duration of diabetes | | | | | | | | |
| 0-5 years | 24 (57.1) | 10 (41.6) | 10 (41.6) | 3 (12.5) | 1 (4.1) | 14 (58.3) | 12 (50.0) | 12 (50.0) |
| 6-10 years | 5 (11.9) | 3 (60.0) | 2 (40.0) | 1 (20.0) | 0 (0.0) | 2 (40.0) | 4 (80.0) | 1 (20.0) |
| >10 years | 13 (31.0) | 1 (7.6) | 5 (38.4) | 5 (38.4) | 2 (15.8) | 12 (92.3) | 10 (76.9) | 3 (23.1) |

This observation is in line the a previous study which found that there was a link between the levels of depression and HbA1c [17]. Studies have also revealed that diabetic patients who had depression, and emotional problems-associated with diabetes, had significantly poorer control of HbA1c [18-20]. A study conducted in Iran (2019) showed that depression level was significantly related to glycemic control (HbA1c level) in which the worse the depression level, higher the HbA1c level [21].

Table 2. Association between depression level and glycemic status among diabetic patients (n=42)

| State of depression | Glycemic control based on HbA1c level | | | p-value |
|---------------------|---------------------------------------|-------------|--------------|---------|
| | Poor, n (%) | Good, n (%) | Total, n (%) | |
| Normal | 3 (23.1) | 10 (76.9) | 13 (100.0) | 0.005 |
| Mild | 13 (76.5) | 4 (23.5) | 17 (100.0) | |
| Moderate | 8 (88.9) | 1 (11.1) | 9 (100.0) | |
| Severe | 2 (66.7) | 1 (33.3) | 3 (100.0) | |
| Total | 26 (61.9) | 16 (38.1) | 42 (100.0) | |

Depression could activate adrenergic receptors located on macrophages because it can trigger psychological stress in the brain. When the receptors are activated, macrophages will release pro-inflammatory cytokines. These cytokines could work in various organs, in particular in the liver, brain, and pancreatic beta cells. In the liver, these cytokines cause an acute phase response characterized by an increase in various substrates or mediators such as glycoproteins, serum amyloid, and C-reactive peptide (CRP). This acute response in the liver could lead insulin resistance. An alternative explanation for this process is the chronic dysregulation of the hypothalamus-pituitary adrenal-axis (HPA-axis) such as high cortisol level and reduced insulin sensitivity or activation of the immune system which promotes chronic inflammatory processes.

There are some limitations of this study. The number of the patients included in this study is relatively small. A study with a larger sample size is therefore required. There are many factors associated with HbA1c level including the adherence to take the diabetic drugs by the patients. In this study, we did not measure the adherence of the patients.

Conclusion

The prevalence of depression is relatively as high among elderly with type 2 diabetes mellitus in *Puskesmas* Belakang Padang, Batam of Indonesia. Our data suggests that depression is associated with the level of HbA1c in this population. Therefore, an interactive and comprehensive strategy to reduce the depression by involving stress management among elderly with type 2 diabetes mellitus is important to be designed and implemented.

Ethics approval

The protocol of this study was approved by the Ethics Committee of Universitas Syiah Kuala, Banda Aceh (No 126/EA/FK-RSUDZA/2020).

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Conflict of interest

The authors declare that they have no competing interests.

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Underlying data

Data supporting the findings of study are available from corresponding author upon request.

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