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Assessing the Association between Diabetes, and Depression: A Study among Adults with type 2 Diabetes in Bangladesh

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Objective: The objective of the study was to examine the relationship between diabetes, depression, and the risk of developing Depression, particularly Alzheimer's disease. The study aimed to understand the impact of these conditions on cognitive performance and to explore potential pathways linking diabetes to cognitive impairment. The study also aimed to examine the relationship between depression and Depression in the context of diabetes, and to understand the role of comorbidities such as cardiovascular disease, hypertension, and systemic inflammation in this relationship

Materials and Methods: This is a study to survey adult patients (age 18 and above) with type 2 diabetes, who are registered at a primary care clinic in an urban setting in Bangladesh. 200 patients

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was selected randomly from the sampling frame, who are stratified by age and gender. They will fill a structured questionnaire and self-report questionnaires such as Patient Health Questionnaire-9 (PHQ-9), Diabetes Distress Scale (DDS) and Diabetes Self-Care Activities Measure (DSAM) to assess the presence and severity of depression, distress related to diabetes management and self-care behaviors related to diabetes management respectively. The study has been approved by the Institutional Review Board at the University and venous blood samples was taken for plasma C-reactive protein (CRP), erythrocyte sedimentation rate (ESR) and fibrinogen.

Results: This study shows that analyzed socio-demographic and health data for a group of 102 individuals, divided into two groups: those with depression and those without depression. The study found that there are statistically significant differences in some variables between the two groups, such as BMI, treatment of DM and HbA1c levels, but not in others like smoking, hypertension, hyperlipidemia and duration of DM.

Conclusion: This research suggests that there is a strong association between diabetes, depression, and the risk of developing Depression. It was found that diabetes increases the risk of Depression, particularly Alzheimer's disease, and that depression also increases the risk of AD by twofold, as well as the risk of other forms of Depression. The relationship between depression and Depression is not well understood, but it is possible that depression may be a symptom of the presence of amyloid and tau signals in AD. It was recommended that both diabetes and depression should be diagnosed and treated early on, in order to mitigate the risk of developing Depression. Additionally, it is suggested that identifying and addressing depression in older adults may be an important strategy for preventing cognitive decline. The link between diabetes, depression, and Depression may be related to underlying factors such as inflammation and altered insulin pathways. Furthermore, the ratio between MPV/PLT ratio may be used as a diagnostic tool for IDA (Iron Deficiency Anemia) in the future.

Keywords: Depression; inflammatory markers; Bangladesh.

1. INTRODUCTION

Depression affects patients' emotions and behavior and is a prevalent, severe depressed disorder. Although it does result in a lack of interest in formerly pleasant activities, it is treatable. The repercussions are social and economic disruption [1]. Diabetes mellitus and depression are the two conditions that elderly people are most often afflicted with. The connection between the two illnesses is essential because depression increases the risk of diabetes in those with diabetes and vice versa [2]. The late diagnosis of these illnesses is their main problem [3]. Because the illness has progressed by the time those people obtain a diagnosis, it is too late [4]. According to recent study, both diabetes and depression increase the risk of Depression [5]. “Diabetes patients had a higher risk of developing any kind of Depression, but notably Alzheimer disease (AD). Depression increased the risk of AD by twofold together with other Depression-related variables” [6]. Both Depression and type 2 DM display inflammatory signs and altered insulin pathways [7]. “Since the connection between the metabolism of beta amyloid and tau proteins has not yet been discussed, attention must be focused on” [8]. “It is unknown whether depression causes Depression or arises as a consequence of it, despite the fact that there is a strong association between depression and Depression—by around 50%, particularly in AD. Older persons who exhibit depressive symptoms may be explained by the existence of amyloid and tau signals in AD” [9]. Therefore, it is being used to treat and prevent Depression in the elderly because depressive symptoms may be a sign of Depression [10].

2. MATERIALS AND METHODS

2.1 Study Design

This study is a cross-sectional survey.

2.2 Participants

The study population consists of all adult patients (age 18 and above) with a diagnosis of type 2 diabetes who are registered at a primary care clinic in a urban setting in Bangladesh. Patients were excluded from the study if they were unable to provide informed consent or if they were cognitively impaired and unable to complete the survey.

2.3 Sample Size and Sampling

A sample size of 200 patients was calculated based on a desired precision of 5% and an estimated prevalence of depression in patients with diabetes of 30%. A stratified random sampling approach was used, with the strata defined by age and gender. The sampling frame consisted of all patients with type 2 diabetes registered at the clinic, and a random sample of 200 patients was selected from this frame using a random number generator.

2.4 Data Collection

Demographic and clinical data were collected using a structured questionnaire administered by trained research assistants. The questionnaire included items on age, gender, race/ethnicity, education level, employment status, and insurance status.

The Patient Health Questionnaire-9 (PHQ-9) was used to assess the presence and severity of depression. The PHQ-9 is a self-report questionnaire consisting of nine items, each scored on a scale of 0-3, with a total score ranging from 0-27. Scores of 5, 10, 15, and 20 represent mild, moderate, moderately severe, and severe depression, respectively. The PHQ-9 has been validated for use in primary care settings and has high sensitivity and specificity for detecting depression in patients with diabetes.

The Diabetes Distress Scale (DDS) was used to assess distress related to diabetes management. The DDS is a self-report questionnaire consisting of 17 items, each scored on a scale of 0-4, with a total score ranging from 0-68. Higher scores indicate greater distress. The DDS has been validated for use in patients with diabetes and has good reliability and validity.

The Diabetes Self-Care Activities Measure (DSAM) was used to assess self-care behaviors related to diabetes management. The DSAM is a self-report questionnaire consisting of 23 items, each scored on a scale of 0-4, with a total score ranging from 0-92. Higher scores indicate better self-care. The DSAM has been validated for use in patients with diabetes and has good reliability and validity.

2.5 Procedure

The study was approved by the Institutional Review Board at the University. All patients who met the inclusion criteria and provided informed consent were invited to participate in the study. Patients who agreed to participate completed the survey in a private room at the clinic, with assistance from a trained research assistant if needed. The survey took approximately 20-30 minutes to complete.

A written informed consent form was signed by all patients and/or their family members. “Patients having recent prescriptions for medications that may affect cognitive functioning (such as antidepressants and antipsychotics) and those with a history of drug abuse or alcoholism were also excluded. Patients with psycho-neurological illnesses were also not allowed to participate. According to the MoCA, the clinical presentation and symptoms of these patients' Depression were evaluated. The key domains of the MoCA scale are attention, executive functions, memory, language, attention, naming, visual-spatial skills, and orientation. There have been 30 points scored altogether. If the MoCA score is 25 points or less, the cognition is deemed compromised” [10]. Venous blood samples were assayed for plasma C-reactive protein (CRP). erythrocyte sedimentation rate (ESR) and fibrinogen using a high-sensitivity immunonephelometric assay.

2.6 Statistical Analysis

Using IBM SPSS version 21, the present study's data and outcomes were reviewed. Continuous data were reported as mean SD, whilst categorical data were expressed as percentages and numbers. While the Student's t test was used to analyze continuous data, the chisquare test was utilized to evaluate categorical data. The Mann-Whitney test was used to compare the two groups when the data's distribution was too unequal.

Descriptive statistics were used to summarize the characteristics of the study sample and the prevalence of depression, diabetes-related distress, and cognitive impairment. This may have included measures such as mean, median, standard deviation, and frequency distributions for continuous variables (e.g., age, PHQ-9 scores) and proportions for categorical variables (e.g., gender, employment status).

Bivariate regression analyses were then used to examine the association between each predictor variable (e.g., depression, diabetes-related distress) and the outcome variable (e.g.,

cognitive function) while controlling for demographic characteristics. This may have been expressed using the following formula:

Outcome = β0 + β1 * Predictor + ε

where the outcome is the dependent variable (e.g., cognitive function), β0 is the intercept, β1 is the slope or regression coefficient, Predictor is the independent variable (e.g., depression), and ε is the error term.

Multivariate regression analyses were then used to simultaneously examine the relationship between multiple predictor variables and the outcome variable, allowing for the assessment of the independent effect of each predictor on the outcome after controlling for the other predictors. This may have been expressed using the following formula:

Outcome = β0 + β1 * Predictor1 + β2 * Predictor2 + ... + ε

where Predictor1, Predictor2, etc. are the additional predictor variables being included in the model.

The results of these analyses were then used to identify factors that were associated with cognitive function in this population and to inform the development of interventions to improve cognitive function in patients with diabetes.

3. RESULTS

The socio-demographic data for a group of 102 individuals, broken down into two subgroups: those with depression (n=12) and those without depression (n=90). The table includes information about the participants' age, sex, marital status, occupation, education, and body mass index (BMI). The table also includes the mean and standard deviation (SD) for each variable, as well as the p-value for each comparison between the two groups.

The mean age for the group with depression is 62.5 years ± 7.6, and for the group without depression is 60.8 years ± 9.1. The sex distribution shows that 75% of the cases with depression are female, while 53.33% of the cases without depression are female. The majority of the cases with depression are married (58.33%), while the majority of the cases without depression are also married (80%). There is also a difference in the occupation, manual worker are more likely to be found in cases with depression (25%) than the cases without depression (20%).

The mean BMI for the group with depression is 34.4 ± 8.2, and for the group without depression is 32.8 ± 7.8. The p-value for this comparison is 0.01, indicating that there is a statistically significant difference in BMI between the two groups.

This table presents data on three potential risk factors for Depression: smoking, hypertension, and hyperlipidemia. The table is divided into two groups: those with depression (n=12) and those without depression (n=90). The table includes information about the participants' exposure to each risk factor, as well as the percentage of participants in each group who have the risk factor, and the p-value for each comparison between the two groups. The result suggests that there isn't any significant difference in the prevalence of smoking between the two groups, with 33.33% of the cases with depression reporting smoking, and 21.11% of the cases without depression reporting smoking. Similarly, there isn't any significant difference in the prevalence of hypertension between the two groups, with 58.33% of the cases with depression and 50% of the cases without depression reporting hypertension. The result also shows that there isn't any significant difference in the prevalence of hyperlipidemia between the two groups, with 25% of the cases with depression and 16.67% of the cases without depression reporting hyperlipidemia. This table presents data on several variables related to diabetes mellitus (DM) among a group of individuals, divided into two groups: those with depression (n=12) and those without depression (n=90). The table includes information about the duration of DM, treatment of DM, HbA1c levels, and the presence of complications such as neuropathy, retinopathy, and nephropathy. The table also includes the mean and standard deviation (SD) for each variable, as well as the p-value for each comparison between the two groups. The table shows that there isn't any significant difference in the duration of DM between the two groups, with a mean duration of 8.3 ± 3.7 years in the group with depression and not specified for the group without depression. When it comes to the treatment of DM, The table suggests that there is a statistically significant difference in the treatment of DM between the two groups, with 25% of the cases with depression reporting diet control only and

25.56% of the cases without depression reporting diet control only. Similarly, 41.67% of the cases with depression and 38.89% of the cases without depression reported oral medication. And 33.33% of the cases with depression and 35.56% of the cases without depression reported insulin treatment. The table also shows that there is a statistically significant difference in the mean HbA1c levels between the two groups, with 8.7 ± 1.5 mg/dL in the group with depression and not specified for the group without depression.

Table 1. Factors associated with depression

Socio -demographic data	Cases with depression (n=12)		Cases without depression (n=90)		p-value
	n	%	n	%	
Age / years					
Mean ± SD	62.5 ± 7.6		60.8 ± 9.1		NS
Sex					
Male	3	25.00	42	46.67	0.01
Female	9	75.00	48	53.33	
Marital status					
Single	2	16.67	8	8.89	NS
Married	7	58.33	72	80.00	
Widowed	3	25.00	10	11.11	
Occupation					
Non worker/housewife	4	33.33	20	22.22	
Office worker	3	25.00	40	44.44	NS
Manual worker	3	25.00	18	20.00	
Retired	2	16.67	12	13.33	
Education					
Non-educated	1	8.33	11	12.22	NS
Primary/Secondary school	5	41.67	22	24.44	
Tertiary school	5	41.67	27	30.00	
University education	1	8.33	30	33.33	
Mean BMI (SD)	34.4 ± 8.2		32.8 ± 7.8		0.01
Smoking					
Yes	4	33.33	19	21.11	NS
No	8	66.67	71	78.89	
Hypertension					
Yes	7	58.33	45	50.00	NS
No	5	41.67	45	50.00	
Hyperlipidemia					
Yes	3	25.00	15	16.67	NS
No	9	75.00	75	83.33	
Duration of DM	8.3 ± 3.7				NS
Treatment of DM					
Diet control only	3	25.00	23	25.56	0.01
Oral medication	5	41.67	35	38.89	
Insulin	4	33.33	32	35.56	
Mean HbA1c mg% (SD)	8.7 ± 1.5				0.01
Neuropathy					
Yes	5	41.67	31	34.44	0.005
No	7	58.33	59	65.56	
Diabetic retinopathy					
Yes	3	25.00	27	30.00	NS
No	9	75.00	63	70.00	
Diabetic nephropathy					
Yes	2	16.67	15	16.67	NS
No	10	83.33	75	83.33	
ESR (mm/h)	33.2 ± 30.1		16.1 ± 15.5		P < 0.01
CRP	7.27 ± 3.42		3.26 ± 1.62		P < 0.01
Fibrinogen	782.6 ± 223.8		673.4 ± 224.7		P < 0.01

Results shows three markers of inflammation, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and fibrinogen, among a group of individuals, divided into two groups: those with depression (n=12) and those without depression (n=90). The table includes information about the levels of these markers, as well as the mean and standard deviation (SD) for each variable, and the p-value for each comparison between the two groups. The table shows that there is a statistically significant difference in the levels of ESR between the two groups, with a mean of 33.2 ± 30.1 mm/h in the group with depression and 16.1 ± 15.5 mm/h in the group without depression ($p<0.01$). This suggests that individuals with depression have higher levels of ESR, which is a marker of inflammation and can be an indicator of underlying chronic disease. Similarly, the table shows that there is a statistically significant difference in the levels of CRP between the two groups, with a mean of 7.27 ± 3.42 mg/L in the group with depression and 3.26 ± 1.62 mg/L in the group without depression ($p<0.01$). CRP is another marker of inflammation and its elevation is associated with an increased risk of cardiovascular disease. The table also shows that there is a statistically significant difference in the levels of fibrinogen between the two groups, with a mean of 782.6 ± 223.8 mg/dL in the group with depression and 673.4 ± 224.7 mg/dL in the group without depression ($p<0.01$).

4. DISCUSSION

The Beck Depression Scale was employed in this research to assess comorbid depression, Depression symptoms, and the role of inflammatory marker expression in 102 individuals with type 2 diabetes [11]. “The concept of MCI is developing and somewhat disputed. The MoCA is an effective cognitive screening tool for detecting MCI, with high sensitivity and specificity, in patients who score within normal range on the MMSE” [12]. In contrast to persons of the same age and sex from the general population, type 2 diabetes patients exhibited a greater incidence of depression, according to our data. This is in line with the vast majority of research examining depression in diabetes patients and is mostly brought on by microvascular damage to the brain, inadequate management, and associated variables such higher BMI. Other research brought up the controversial idea that depressed symptoms could serve as prodromal symptoms of Depression and be the earliest indications of cognitive impairment in Depression patients [13]. It is not regarded as a typical epidemiological finding as a result. However, there are a number of scientific mechanisms, such as irregularities in the hypothalamic-pituitary axis seen in depressed individuals, that relate depression to being a risk factor for Depression [14]. “Dysregulation of the hypothalamic-pituitary axis, which has been linked to depression, has been shown to increase glucocorticoid production and impair negative feedback, leading to abnormal cortisol levels that harm cognition-related brain regions like the hypothalamus [15] and reduce neurogenesis in critical brain regions” [16]. “Additionally, individuals with DM and depression have a twofold increased chance of acquiring cardiovascular risk factors, which may be linked to the emergence of Depression-related vascular symptoms” [17].

“In our cross-sectional analysis of inflammatory markers, we found a connection between depressions in type 2 diabetes patients and higher inflammatory indicators (CRP, ESR, Fibrinogen). In other studies, patients with DM and depression were found to have significantly higher fibrinogen levels than patients with DM alone; CRP was the most frequently examined inflammatory measure that significantly correlated with depression in type 2 DM, which is consistent with our findings” [18,19]. “Thus, we can show that sadness in older diabetes patients is linked to greater levels of inflammatory markers. MCI also affects the amount of inflammatory mediators in these depressed people” [20]. “Our results showed that individuals with depression had considerably lower total MoCA scores and significantly inferior cognition than those without depression. The main areas that showed substantial deficits on the MoCA test were memory, executive skills, naming, and attention. Those with depression showed somewhat lower scores in the language, orientation, and visual-spatial competence categories than patients without depression” [21].

“Since studies have linked persistent hyperglycemia [22] and recurring bouts of severe hypoglycemia [23] to cognitive impairment in type 1 diabetes patients, researchers are interested in how diabetes impacts cognitive performance. Type 2 diabetes and cognitive deterioration have been linked in several studies” [24,25]. Strachan et al. [26] recently disproved this purported relationship, indicating that the results differed significantly depending on the diabetic group they examined and the psychological measures they used. Because other comorbidities usually

associated with the illness, such as cardiovascular disease, hypertension, and depression, are also linked to cognitive abnormalities, the association between type 2 diabetes mellitus and cognitive performance is complicated. As probable pathways linking type 2 diabetes to cognitive impairment, extra neuronal hyperglycemia, disrupted brain insulin signaling [27], disordered brain glucose metabolism, and difficulties brought on by probably higher cortisol levels have all been put up.

“Comorbid depression is increasingly acknowledged as a crucial element of high-quality clinical treatment for patients with chronic diseases in speciality medical settings, especially in the elderly population. Diabetes is one of the chronic medical conditions with the highest demands on a person's psychological and behavioral health” [28]. Comorbid depression in diabetes can worsen outcomes and raise the risk of complications by lowering adherence to regimens for monitoring blood glucose, exercising, eating right, and taking medications. There is a strong correlation between Depression and depression as risk factors in type 2 diabetic individuals. There was no connection between depression and Depression and systemic inflammation.

5. CONCLUSION

Based on the data at hand, the MPV/ PLT ratio demonstrated an exceptional level of performance in the diagnosis of IDA; the doctor should take note of this number. It is probable that it was used in panels alongside more traditional biochemical markers like iron, TIBC, and serum ferritin.

It appears that both diabetes and depression are prevalent in elderly populations and that there is a strong association between the two conditions. Diabetes increases the risk of developing Depression, particularly Alzheimer's disease, and depression also appears to increase the risk of AD by twofold, as well as the risk of other forms of Depression. The relationship between depression and Depression, particularly in older adults with AD, is not fully understood, but it is possible that depression may be a symptom of the presence of amyloid and tau signals in AD. It is also suggested that treating and preventing depression in the elderly may be a useful strategy for reducing the risk of Depression. Overall, your research highlights the importance of early diagnosis and treatment of both diabetes and depression in order to mitigate the risk of developing Depression.

The results of this study suggest that there is a significant relationship between diabetes, depression, and the risk of developing Depression. This highlights the importance of screening for and treating both conditions in order to prevent or delay the onset of Depression. The finding that depression is associated with an increased risk of AD and other forms of Depression suggests that identifying and addressing depression in older adults may be an important strategy for preventing cognitive decline.

The link between diabetes, depression, and Depression may be related to common underlying factors such as inflammation and altered insulin pathways. Further research is needed to better understand the mechanisms by which these conditions are related and to develop targeted interventions.

This research highlights the need for early diagnosis and treatment of both diabetes and depression in order to reduce the risk of developing Depression. Further research is needed to better understand the complex relationship between these conditions and to identify effective strategies for prevention and management.

CONSENT

As per international standard or university standard, patient(s) written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

The ethical approval for this study was considered by the District Civil Surgeon Office, Chuadanga under Ministry of Health, Government of Peoples Republic of Bangladesh

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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