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Mind and Metabolism: An Approach to Understanding the Interactions between Depression and Metabolic Syndrome

Diviya Bharathi Ravikumar, Barath Prashanth Sivasubramanian, Abinaya Sabarinath, Aiswariyam Raamanathan, Husna Qadeer
Department of Internal Medicine, ESIC Medical College and Postgraduate Institute of Medical Science and Research, Chennai, Tamilnadu, India

Barath Prashanth Sivasubramanian
Postdoctoral Research Fellow, Department of Infectious Diseases
University of Texas Health Science Centre, San Antonio, Texas, USA - 78229

Vikramaditya Samala Venkata
Department of Internal Medicine
Physician at Hospital Medicine Division Cheshire Medical Center/Dartmouth Hitchcock Keene NH USA 03431

Abstract:-

Introduction: Depression affects 3.8% of the world's population, while metabolic syndrome (MetS) affects 20% to 30% of the adult population in most countries. Our aim is to determine the association between the two comorbidities using the Public Health Questionnaire-9 scale (PHQ-9) and the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III).

Methods: A cross-sectional study was conducted at a tertiary healthcare hospital in South India, using consecutive non-probabilistic sampling. A total of 332 eligible adults above 18 years of age consented. The PHQ-9 for depression and NCEP-ATP III for MetS were used. The data was collected, coded, and analyzed using chi-square and linear regression techniques to determine the significance and strength of the relationship between MetS and depression.

Results: Out of 332 participants, the overall prevalence of MetS in the study was 53.01% (n=176). The mean age of participants with metabolic syndrome is significantly higher than those without MetS (49.06±8.49 vs 46.32±9.23 years, p-value=0.005). Depression was identified in 17.16% (n=57) of the entire study population and the mean age of participants with depression was lesser than those without depression (46.96±8.75 years vs 47.94±8.99, p-value=0.454). Depression was more prevalent among those with MetS when compared to those without MetS (21.02% vs 12.82%, p=0.048). Of the diagnostic criteria of MetS, components such as waist circumference (87.7% vs 36.6%), high triglyceride levels (49.1% vs 38.5%), and high blood pressure (33.1% vs 29.1%) were higher among those with depression compared to those without depression. Linear regression analysis showed a positive association between MetS and depression score (standardized regression coefficient was 0.194, 95% CI=0.402-1.369, p<0.001).

Conclusion: Subjects with MetS are significantly older than subjects without Mets. There is a significant association between MetS and depression. Early identification of depression in patients with MetS is important and can enhance their quality of life.

Keywords:- *Depression; Diabetes; Metabolic syndrome; Mental health; Hypertension.*

I. INTRODUCTION

Depression is a prevalent psychiatric disorder that affects 28 - 29% of individuals seeking primary care in the United States and about 12.2% of the population in South Asia is affected by mental disorders [1,2]. Metabolic syndrome (MetS) affects 20% to 30% of the adult population in most countries, with a prevalence of around 25% in India. Particularly the prevalence of MetS among women is higher than in men (31% vs 18.5%) [3–5].

Existing evidence is unclear regarding the association between depression and metabolic syndrome. While some studies mainly from the United States and the UK showed a clear association between depression and metabolic syndrome [6–10], other studies from other parts of the world, including China, Turkey, and Finland did not show any association between depression and MetS [11–13].

Our study aimed to investigate the prevalence of depression among patients visiting the tertiary care hospital, identify a potential association between metabolic syndrome and depression, gender-specific differences in this association, and the relationship between specific components of metabolic syndrome and depression in adults who attended the Annual Preventive Health Clinic at a tertiary care center in South India.

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II. METHODS

A. Study Design & Study Sample

This prospective observational study was conducted for six months from August 2022 to February 2023 at a Tertiary healthcare hospital's Annual Preventive Healthcare Clinic (APHC) in Chennai, South India. The study focused on adults presented to the APHC to undergo health evaluations to assess potential health risks. The APHC adheres to established guidelines and protocols for providing preventive services. A total of 332 eligible adults above 30 years of age who had undergone laboratory examinations during the last three months for fasting plasma glucose and lipid profiles were informed about the study and they consented to participate. At the same time, individuals with severe illnesses, cognitive impairment, psychiatric history, pregnant females, or inability to complete survey tasks were excluded.

B. Study instruments

Metabolic Syndrome (MetS) can be diagnosed using the NCEP ATP III criteria [14]. Table 1 depicts the NCEP ATP III criteria for diagnosing Metabolic Syndrome.

The Patient Health Questionnaire (PHQ-9) is commonly used in primary healthcare settings to screen for depression. It consists of nine items that assess depressive symptoms, with each item corresponding to one of the DSM-IV diagnostic criteria for major depressive disorder. Participants were asked to report the frequency with which they had experienced each of the depressive symptoms over the past two weeks. Response options included "not at all", "several days", "more than half the days", and "nearly every day", and were assigned scores of 0, 1, 2, and 3, respectively. PHQ-9 scores range from 0 to 27 and with scores of ≥5, ≥10, and ≥15, representing mild, moderate, and severe levels of depression severity. Individuals with a PHQ-9 score greater than 10 are considered to be suffering from severe depression symptoms. The height and weight of the patient were measured in a standing position using a measuring tape and a weighing scale, respectively. The waist circumference was measured at the midpoint between the lowest rib and iliac crest. A modified Kuppuswamy scale was used to assess the socio-economic status of the study participants.

C. Statistical Analysis:

Data was collected, verified, and analyzed using SPSS software using appropriate statistical tests. All continuous variables were represented as Mean±SD. The chi-square test was used to compare categorical variables. Regression analysis to identify the association between metabolic syndrome and depression. A p-value of ≤0.05 was considered statistically significant.

D. Expected outcomes

We expected to find the prevalence of depression among the patients visiting the tertiary care center, identify the potential association between metabolic syndrome and depression, and gender-specific differences in this association. We expected to establish a relationship between specific components of metabolic syndrome and depression among the participants.

E. Ethical Consideration and Funding

This study has been approved by the ethics committee with reference number IEC/2022/1/07. Written informed consent was obtained from all participants in their own language. Patients consented to the collection, analysis, and publication of the findings of the research. Data collected were de-identified to maintain participant anonymity. No funding was used for this study.

Table 1: NCEP - ATP III criteria for diagnosing Metabolic syndrome

S.no	Characteristic	Criteria
1.	Waist Circumference	≥102 cm for men and ≥88 cm for women
2.	Blood Pressure	≥130/85 mmHg or current use of antihypertensive medication
3.	Triglyceride	≥ 150 mg/dL or current use of medication for hypertriglyceridemia
4.	HDL	<40 mg/dL for men or <50 mg/dL for women or current use of medication for lowering HDL levels.
5.	Fasting plasma glucose	≥100 mg/dL or Current use of antidiabetic medication

III. RESULTS

Metabolic syndrome (MetS) was identified in 176 participants, which is a prevalence of 53.01%. The mean age of participants with metabolic syndrome is significantly higher than those without metabolic syndrome (49.06±8.49 vs 46.32±9.23 years, p-value=0.005).

MetS was more common in women when compared to men (65.69% vs 39.37%, Chi-square value of 23.057, p-value <0.001). Table 2 shows the Socio-Demographic characteristics of the participants.

Depression was identified in 57 participants, which accounts for a prevalence of 17.16%.

The mean age of participants with depression lesser than those without depression is 46.96±8.75 vs 47.94±8.99 years, p-value=0.454, and depression was more common in women when compared to men (23.74% vs 15%, Chi-square value of 1.021, p-value=0.312). Figure 1 & Table 3 shows the gender-based classification of the severity of depression.

Our analysis showed that, among the components of metabolic syndrome, all the components except high fasting plasma glucose (63.2% vs 78.2%) and elevated HDL levels (59.6% vs 62.9%), showed a higher prevalence of depression compared to those without depression. Waist circumference (87.7% vs 36.6%), high triglyceride levels (49.1% vs 38.5%), and high blood pressure (33.1% vs 29.1%) were higher among those with depression compared to those without depression. However, only two out of the five components, waist circumference (p<0.001), and high fasting plasma glucose levels (p=0.016) were significantly associated. Table 4 shows the association of the components of Metabolic Syndrome with depression.

Linear regression analysis was performed with the metabolic syndrome score as the independent variable and the PHQ9 score as the dependent variable. The standardized regression coefficient was 0.194 (95% CI=0.402-1.369, p-value of <0.001). This indicates a positive association between metabolic syndrome and depression.

IV. DISCUSSION

Our study sought to determine this association using the Public Health Questionnaire-9 scale (PHQ-9) and the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III). We demonstrated that metabolic syndrome (MetS) is common among middle-aged individuals, particularly females. We found that the epidemiology of depression is higher in those with MetS compared to the normal population. We also noted the significant association of depression with two out of the five components of the MetS criteria. Finally, we found a positive association between the MetS and depression using linear regression.

Our analysis showed those with a higher age were more likely to have MetS than those without MetS (49.06±8.49 vs 46.32±9.23 years, p-value=0.005) and this is similar to the findings of Zhang et al (55.62±15.92 vs 44.94±17.48 years, p-value = 0.014) [7]. However, a slightly younger mean age was noted with those with depression compared to those without depression (46.96±8.75 years vs 47.94±8.99.

Table 2: Socio-Demographic characteristics of the participants

S.No	Characteristics	Categories	No. (%) with Metabolic Syndrome (n=176)	No. (%) without Metabolic Syndrome (n=156)	p-value
1	Age	30 – 35 years (n=31)	7 (4%)	24 (15.4%)	0.001
		36 – 50 years (n=182)	103 (58.5%)	79 (50.6%)	
		51 – 60 years (n=89)	45 (25.6%)	44 (28.2%)	
		>60 years (n=30)	21 (11.9%)	9 (5.8%)	
2	Sex	Male (n=160)	63 (35.8%)	97 (62.2%)	0.001
		Female (n=172)	113 (64.2%)	59 (37.8%)	
3	Education	No Schooling (n=117)	63 (35.8%)	54 (34.6%)	0.757
		Completed School (n=166)	90 (51.1%)	76 (48.7%)	
		Undergraduate (n=40)	18 (10.2%)	22 (14.1%)	

		Postgraduate (n=9)	5 (2.8%)	4 (2.6%)	
4	Occupation	Unemployed (n=98)	52 (29.5%)	46 (29.5%)	0.734
		Unskilled (n=134)	75 (42.6%)	59 (37.8%)	
		Skilled (n=80)	40 (22.7%)	40 (25.6%)	
		Professional (n=20)	9 (5.1%)	11 (7.1%)	
5	Religion	Hindu (n=312)	156 (88.6%)	156 (87.2%)	0.751
		Muslim (n=14)	7 (4%)	7 (4.5%)	
		Christian (n=25)	13 (7.4%)	12 (7.7%)	
		Jain (n=1)	0 (0%)	1 (0.6%)	
6	Marital Status	Unmarried (n=20)	7 (4%)	13 (8.3%)	0.244
		Married (n=293)	160 (90.9%)	133 (85.3%)	
		Divorced / Separated (n=4)	1 (0.6%)	3 (1.9%)	
		Widowed (n=15)	8 (4.5%)	7 (4.5%)	

Table 2 shows the socio-demographic characteristics of the sample included in the study. It is seen that more than half the sample belonged to the 36-50 years age group and more participants have metabolic syndrome compared to those without metabolic syndrome (58.5% vs 50.6%) with a significance of 0.001. Therefore, this sample is representative of largely the working-class group of people. There is an almost equal distribution of men and women in the entire sample. However, less number of males have metabolic syndrome compared to females (35.8% vs 64.2%, p=0.001). The presence of metabolic syndrome was similar to those without metabolic syndrome in those who completed schooling (51.1% vs 48.7%) and who have an undergraduate (10.2% vs 14.1%) with a p-value of 0.734. Likewise, occupation, religion, and marital status did not increase the prevalence of metabolic syndrome.

Table 3: Shows the gender-based classification of the severity of depression

S no	Depression Severity	Frequency	Male (n = 160)	Female (n = 172)
1	No Depression	98 (29.5%)	36 (22.5%)	62 (36%)
2	Minimal Depression	96 (28.9%)	56 (35%)	40 (23.2%)
3	Mild Depression	81 (24.4%)	44 (27.5%)	37 (21.5%)

4	Moderate Depression	33 (9.9%)	14 (8.7%)	19 (11%)
5	Moderately Severe Depression	16 (4.8%)	9 (5.6%)	7 (4%)
6	Severe Depression	8 (2.4%)	1 (0.6%)	7 (4%)

The prevalence of moderate and severe depression is found to be lower among men compared to women (8.7% vs 11%, and 0.6% vs 4% respectively). However, moderately severe depression was more common among men compared to women (5.6% vs 4%).

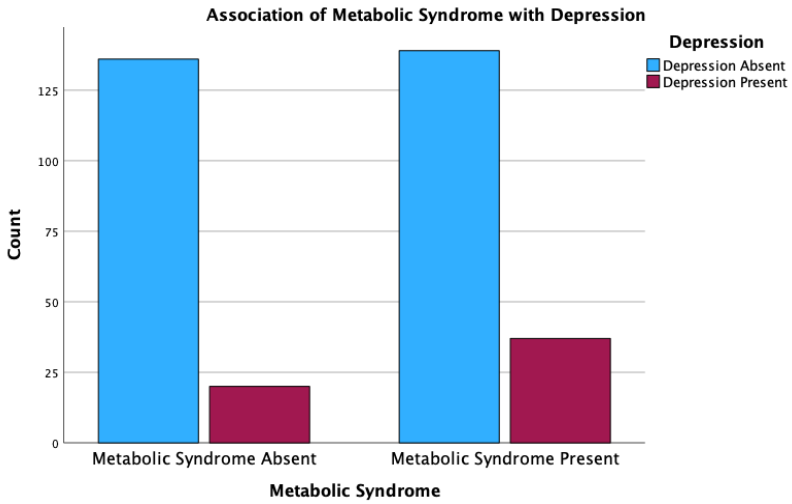

Fig 1: Association metabolic syndrome with depression

It is seen that among those with metabolic syndrome, the prevalence of depression is slightly higher compared to those without metabolic syndrome (21.02% vs 12.82%, Chi-square value is 3.912, p-value is 0.048).

Table 4: Association of depression with the criteria of MetS

S.no	Characteristic	Among those with Depression (n=57)	Among those without Depression (n=275)	p-value
1.	High Waist circumference (n=150)	50 (87.7%)	100 (36.4%)	p<0.001
2.	High Fasting Plasma Glucose levels or taking diabetic medications (n=251)	36 (63.2%)	215 (78.2%)	p=0.016
3.	Low HDL levels (n=207)	34 (59.6%)	173 (62.9%)	p=0.644
4.	High Triglyceride levels or taking drugs for hypertriglyceridemia (n=134)	28 (49.1%)	106 (38.5%)	p=0.139
5.	High Blood Pressure or taking drugs for Hypertension (n=99)	19 (33.3%)	80 (29.1%)	p=0.524

Shows the association of the components of Metabolic Syndrome with depression. Waist circumference (87.7% vs 36.6%), high triglyceride levels (49.1% vs 38.5%), and high blood pressure (33.1% vs 29.1%) were higher among those with depression compared to those without depression.

p-value=0.454). The mean age of our study sample with depression was also younger than the findings of Yu et al (57.07±10.27 years) [11]. The difference in mean age is because our study sample included a majority of working-class participants between the age group of 36 to 50 years. We reported females were commonly found to have MetS (64.2% vs 35.8%, p-value= 0.001) and depression (23.74% vs 15%, p-value=0.312) compared to males. This is similar to the findings of Zhang et al where females have a higher

prevalence of MetS (51.15% vs 48.85%) [7] and of Yu et al where females were found to have a higher prevalence of depression (8.1% vs 3.5%) [11].

We found the prevalence of metabolic syndrome (MetS) was 53.01% and MetS was more common among women (65.69%). This is consistent with previous studies [12,15]. Depression was more prevalent among those with MetS when compared to those without MetS (21.02% vs 12.82%, p=0.048). Our analysis showed, that two out of the five components of the MetS, which were high waist circumference (87.7%) and high fasting plasma glucose levels (63.2%) were significantly associated with the occurrence of depression. However, Demirci et al showed there was no association between the components of MetS and depression. This could be due to the smaller sample size in this study [12]. Hossain et al showed that the prevalence of depressive disorders ranged from 15.3% to 56.6% among those with diabetes [2]. We found a positive association between PHQ-9 scores and the metabolic syndrome scores (standardized regression coefficient = 0.1914, 95% CI=0.019-0.066, p-value of <0.001). This is similar to the findings of Brinkmann et al, which reported a positive association between PHQ-9 scores and stroke and heart disease [16]

The strength of the study is the large representation of a single community and we had adequate representation from all age groups, and across different types of education and occupation. We were able to estimate the incidence of depression from the sample population. Being a cross-sectional study, the causality between depression and metabolic syndrome was not established. Due to the retrospective nature of the study, we were unable to control the unidentified confounding variables. We used a questionnaire to evaluate the participants but a comprehensive psychiatric evaluation could not be performed. Though, the participants included did not have previous diagnoses of psychiatric disorders and we were able to identify the occurrence of depression but we couldn't identify if depression was part of a bipolar disorder or major depressive disorder. Additionally, we were not able to isolate participants with hypothyroidism. We failed to address potential mechanisms and lab values to determine the inflammatory effect of depression.

V. CONCLUSION

The significance of screening for metabolic syndrome and mental illness particularly depression in middle-aged adults cannot be overstated. Our analysis revealed a substantial association between these two conditions. It is imperative to emphasize the importance of early identification and the implementation of a comprehensive approach to address these disorders. By adopting a holistic approach, healthcare professionals can effectively manage and mitigate the impact of metabolic syndrome and mental illness in this population.

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