A Study on Components of Metabolic Syndrome among the Non-Diabetic Obese

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Abstract

Background: *Metabolic syndrome is a cluster of interrelated metabolic abnormalities, including central obesity, insulin resistance, hypertension, dyslipidemia, and elevated fasting blood glucose levels. It significantly raises the risk of cardiovascular diseases and other health complications. This study focuses on the components of metabolic syndrome among non-diabetic obese individuals, who are particularly vulnerable to these metabolic disturbances due to excess adiposity. To assess the prevalence and associations of metabolic syndrome components among non-diabetic obese individuals.*

Materials and methods: *A cross-sectional study was conducted at Chittagong Medical College Hospital from July 2020 to June 2021. The study enrolled 100 non-diabetic obese individuals aged 30 to 70 years, excluding those with diabetes, infections, liver or renal diseases, cardiovascular conditions, malignancies, endocrine disorders, or those on certain medications. Data on socio-demographic characteristics, anthropometric measures, serum lipid profiles, and fasting blood glucose levels were collected and analyzed using Microsoft Excel and IBM-SPSS v.20. Statistical significance was determined using the Student's 't' test and chi-square (χ^2) test with a p-value < 0.05.*

Results: *The majority of participants were under 40 years of age, predominantly female and mostly service holders. Elevated blood pressure was observed in 25% of participants. Anthropometric measures showed a mean BMI of 32.57 kg/m² and a mean waist circumference of 104.63 cm. Metabolic syndrome was present in 52% of participants. Dyslipidemia was prevalent, with 50% exhibiting elevated triglycerides and 46% having decreased HDL cholesterol. Notably, 42% of participants were prediabetic. Significant associations were found between metabolic syndrome and elevated triglycerides (p < 0.001), increased LDL cholesterol (p < 0.05), and decreased HDL cholesterol (p < 0.05).*

Conclusion: *The study underscores the high prevalence of metabolic syndrome and associated dyslipidemia among non-diabetic obese individuals. The significant correlation between these metabolic abnormalities highlights the need for early detection and management strategies to mitigate the progression to type 2 diabetes and cardiovascular diseases.*

Key words: Dyslipidemia; HDL cholesterol; Metabolic syndrome; Non-diabetic obese; Pre-diabetes; Triglycerides.

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INTRODUCTION

Metabolic syndrome is a cluster of interrelated metabolic abnormalities that significantly increase the risk of cardiovascular disease, stroke, and other health complications. Among non-diabetic obese individuals, the components of metabolic syndrome are particularly prevalent, reflecting the profound impact of excess

adiposity on metabolic health.[1-3] These components include central obesity, insulin resistance, hypertension, dyslipidemia (Characterized by elevated triglycerides and low HDL cholesterol), and elevated fasting blood glucose levels. Together, these factors create a pro-inflammatory and pro-thrombotic state, exacerbating the risk of chronic diseases.[4,5]

Central obesity, typically measured by waist circumference, is a key driver of metabolic syndrome, as it is strongly associated with insulin resistance—a condition where the body's cells become less responsive to insulin, leading to elevated blood sugar levels. Hypertension and dyslipidemia further compound the risk, as they contribute to atherosclerosis and other cardiovascular issues.[6-8] Understanding these components in non-diabetic obese individuals is crucial for early identification and intervention, aiming to mitigate the progression of metabolic syndrome and its associated health risks. To assess the components of metabolic syndrome among the non-diabetic obese

MATERIALS AND METHODS

The study was a cross-sectional study conducted at the Department of Biochemistry and Endocrinology, Chittagong Medical College Hospital, from July 2020 to June 2021. Non-diabetic obese individuals aged between 30 and 70 years were enrolled through non-probability convenient sampling based on specific inclusion criteria. Participants with diabetes mellitus, acute infections, active liver or renal disease, cardiovascular disease, malignant disease, endocrine disorders, or those taking antihypertensive, lipid-lowering drugs or corticosteroids were excluded. Informed consent was obtained from all participants and relevant clinical, medical, demographic, and socioeconomic data were recorded using a predesigned case record form. The study received approval from the Ethical Review Committee at Chittagong Medical College.

Data processing and analysis were performed using Microsoft Excel and IBM-SPSS v.20 for Windows. Statistical inference was made with a 95% confidence interval, and a p-value of < 0.05 was considered statistically significant. Variables were expressed as mean ± Standard Errors of Mean (SEM) and associations were assessed using the Student's 't' test and chi-square (χ^2) test.

RESULTS

Table I Distribution of baseline socio-demographic characteristics among the study subjects (Non-Diabetic Obese) (n = 100)

Socio-demographic Variables		Frequency	Percentage (%)
Age in Groups	< 40 Years	52	52.0
	40 – 49 Years	37	37.0
	50 Years	11	11.0
Sex	Male	45	45.0
	Female	55	55.0
Occupation	Service Holder	55	55.0
	House Wife	27	27.0
	Businessman	10	10.0
	Others	08	8.0

Socio-demographic Variables		Frequency			Percentage (%)
BP Status	Elevated			25	25.0
	Normal			75	75.0
		n	Mean	± SEM	Median	Range
Age (Years)		100	40.25	0.85	39.00	30 – 75
Systolic BP (mmHg)		100	122.09	1.52	120.00	90 – 160
Diastolic BP (mmHg)		100	81.20	0.94	80.00	60 – 100

In this study of 100 non-diabetic obese individuals, the majority (52%) were under 40 years of age, with a mean age of 40.25 years. The cohort was predominantly female (55%) and more than half were service holders (55%), followed by housewives (27%), businessmen (10%) and others (8%). Blood pressure measurements revealed that 25% of participants had elevated blood pressure, while the remaining 75% had normal levels. The mean systolic blood pressure was 122.09 mmHg, with a range of 90 to 160 mmHg, and the mean diastolic blood pressure was 81.20 mmHg, ranging from 60 to 100 mmHg.

Table II Distribution of anthropometric variables among the study subjects (Non-Diabetic Obese) (n = 100)

	n	Mean	± SEM	Median	Range
BMI (Kg/m^2)	100	32.57	0.48	31.20	25.8 – 54.2
Waist Circumference (cm)	100	104.63	0.75	104.00	89 – 133

Obesity Status by BMI	Frequency	Percentage (%)
Obese Class I	76	76.0
Obese Class II	18	18.0
Obese Class III	06	6.0
Total	100	100.0

The anthropometric analysis of the 100 non-diabetic obese participants revealed an average Body Mass Index (BMI) of 32.57 kg/m², with values ranging from 25.8 to 54.2 kg/m². The mean waist circumference was 104.63 cm, with a range from 89 to 133 cm, indicating central obesity among the participants. When categorized by obesity class based on BMI, the majority (76%) fell into Obese Class I, 18% were in Obese Class II and 6% were classified as Obese Class III, reflecting varying degrees of obesity within the study group.

Table III Distribution of metabolic syndrome among the study subjects (Non-Diabetic Obese) (n = 100)

Metabolic Syndrome	Frequency	Percentage (%)
Present	52	52.0
Absent	48	48.0
Total	100	100.0

In this study of 100 non-diabetic obese individuals, metabolic syndrome was present in 52% of the participants, while 48% did not meet the criteria for metabolic syndrome. This indicates that just over half of the study population exhibited the cluster of metabolic abnormalities associated with increased cardiovascular and metabolic risks.

Table IV Distribution of serum lipid profiles among the study subjects (Non-Diabetic Obese) (n = 100)

	n	Mean	± SEM	Median	Range
Serum Total Cholesterol (mg/dl) (Normal Level)	100	157.51	3.32	155.50	100 – 250
Serum Triglyceride (mg/dl) (Normal Level)	100	173.80	6.17	149.50	109 – 345
Serum LDL (mg/dl) (Normal Level)	100	80.61	2.28	80.50	47 – 161
Serum HDL (mg/dl) (Normal Level)	100	40.81	0.28	41.00	34 – 46

Serum Lipid Profile Status		Frequency	Percentage (%)
Serum Total Cholesterol	Increased	13	13.0
	Normal	87	87.0
Serum Triglyceride	Increased	50	50.0
	Normal	50	50.0
Serum LDL	Increased	24	24.0
	Normal	76	76.0
Serum HDL	Decreased	46	46.0
	Normal	54	54.0
	Total	100	100.0

The analysis of serum lipid profiles among the 100 non-diabetic obese participants revealed a mean serum total cholesterol level of 157.51 mg/dl, with values ranging from 100 to 250 mg/dl. Serum triglyceride levels had a mean of 173.80 mg/dl, ranging from 109 to 345 mg/dl. The mean LDL cholesterol level was 80.61 mg/dl, with a range of 47 to 161 mg/dl, and the mean HDL cholesterol level was 40.81 mg/dl, with a range from 34 to 46 mg/dl.

In terms of lipid profile status, 13% of participants had elevated total cholesterol levels, 50% had elevated serum triglycerides, 24% had elevated LDL cholesterol, and 46% had decreased HDL cholesterol. This distribution highlights a significant prevalence of dyslipidemia, particularly in the form of high triglycerides and low HDL cholesterol, among the non-diabetic obese individuals in this study.

Table V Distribution of fasting blood glucose among the study subjects (Non-Diabetic Obese) (n = 100)

	n	Mean	± SEM	Median	Range
Fasting Plasma Glucose (mg/dl)	100	99.02	2.07	97.00	70 – 140

FPG Status	Frequency	Percentage (%)
Pre-Diabetic	42	42.0
Normal	58	58.0
Total	100	100.0

The fasting plasma glucose levels in the 100 non-diabetic obese participants had a mean of 99.02 mg/dl, with values ranging from 70 to 140 mg/dl. Among the participants, 42% were classified as pre-diabetic, while 58% had normal fasting glucose levels. This indicates a notable proportion of individuals in the pre-diabetic range, reflecting a significant risk of progressing to type 2 diabetes if preventive measures are not taken.

Table VI Association between metabolic syndrome and serum lipid profiles among the non-diabetic obese (With Chi-square (χ^2) test significance) (n = 100)

Lipid Profiles		Metabolic Syndrome		p Value
		Present (n = 52)	Absent (n = 48)	
Serum TC Status	Increased (n = 13)	10 (19.2)	3 (6.2)	p < 0.05 Significant
	Normal (n = 87)	42 (80.8)	45 (93.8)	
Serum TG Status	Increased (n = 50)	39 (75.0)	11 (22.9)	p < 0.001 Very Highly Significant
	Normal (n = 50)	13 (25.0)	37 (77.1)	
Serum LDL Status	Increased (n = 24)	18 (34.6)	6 (12.5)	p < 0.05 Significant
	Normal (n = 76)	34 (65.4)	42 (87.5)	
Serum HDL Status	Decreased (n = 46)	29 (55.8)	17 (35.4)	p < 0.05 Significant
	Normal (n = 54)	23 (44.2)	31 (64.6)	

● Figures within parentheses indicate percentages

The association between metabolic syndrome and serum lipid profiles among the 100 non-diabetic obese participants revealed significant correlations. Among those with metabolic syndrome, 19.2% had increased Total Cholesterol (TC) levels compared to 6.2% without metabolic syndrome (p < 0.05). For serum Triglycerides (TG) a substantial 75% of those with metabolic syndrome had elevated levels, in contrast to only 22.9% without metabolic syndrome (p < 0.001), indicating a very high significance. Elevated LDL cholesterol was present in 34.6% of those with metabolic syndrome versus 12.5% in those without (p < 0.05) while decreased HDL cholesterol was found in 55.8% of those with metabolic syndrome compared to 35.4% without (p < 0.05). These results underscore the strong associations between dyslipidemia and the presence of metabolic syndrome in this population.

DISCUSSION

The findings from this study on the components of metabolic syndrome among non-diabetic obese individuals align with the

broader body of research, emphasizing the heightened prevalence of metabolic abnormalities within this population. In this study, 52% of participants were found to have metabolic syndrome, a rate comparable to other studies conducted in similar populations. For instance, research conducted in one report has reported metabolic syndrome prevalence rates ranging from 30% to 60% among obese individuals, depending on the specific criteria used and the population's characteristics.[5] The consistency in these findings underscores the global impact of obesity on metabolic health, irrespective of geographical or demographic differences.

The significant association between serum triglyceride levels and the presence of metabolic syndrome observed in this study is particularly noteworthy. This aligns with studies., which identified elevated triglycerides as a central feature of metabolic syndrome, often preceding the onset of other metabolic disturbances.[6] The high prevalence of hypertriglyceridemia (50%) and low HDL cholesterol levels (46%) in this study further corroborates the dyslipidemic profile commonly associated with obesity, reinforcing the need for lipid management in this population. Moreover, the significant correlation between elevated LDL cholesterol and metabolic syndrome found here mirrors findings from studies that highlight LDL as a key factor in cardiovascular risk, particularly when combined with other metabolic abnormalities.

The study also revealed a substantial proportion of participants (42%) with pre-diabetic fasting plasma glucose levels, which is consistent with other research linking obesity to insulin resistance and impaired glucose metabolism. Similar studies, conducted in Asian populations, have reported pre-diabetes prevalence rates of 40-50% among obese individuals, reflecting the universal nature of this metabolic dysfunction.[7] This finding emphasizes the critical need for early screening and intervention to prevent the progression to type 2 diabetes, especially in populations with a high prevalence of obesity.

The results of this study are consistent with previous research on metabolic syndrome in non-diabetic obese populations, highlighting the high prevalence of dyslipidemia, insulin resistance, and associated cardiovascular risks. The significant associations between these components further validate the interrelated nature of metabolic syndrome and underscore the importance of comprehensive management strategies in this high-risk group. Addressing these metabolic abnormalities through lifestyle interventions, pharmacotherapy and regular monitoring is essential to reducing the long-term health risks associated with obesity.

CONCLUSION

The study highlights the widespread occurrence of metabolic syndrome and dyslipidemia among non-diabetic obese individuals. The strong associations between these metabolic disturbances emphasize the importance of early detection and targeted management to prevent the progression to type 2 diabetes and cardiovascular diseases.

DISCLOSURE

All the authors declared no competing interest.

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