



Original Research Article

PREVALENCE OF METABOLIC SYNDROME IN A RURAL POPULATION OF KARACHI, PAKISTAN: A 6-MONTH CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Metabolic syndrome is a set of cardiometabolic dysfunctions which significantly increases the risk of cardiovascular disease and type 2 diabetes mellitus. It is rapidly increasing across the globe, but the information based on community-based research of rural population in Pakistan is minimal. The objective is to determine the prevalence of metabolic syndrome and its associated risk factors among adults residing in a rural population of Karachi, Pakistan.

Materials and Methods: This cross-sectional research was carried out in the six months at the Baqai Fatima Hospital, Karachi. A non-probabilistic convenience sampling plan was used to recruit a group of adults between 18 years and above who were in rural locations. The data collected involved the passage of structured interview, anthropometric measurements, blood pressure measurements, and the performance of fasting bio-chemical tests. The operational definition of metabolic syndrome was based on the National Cholesterol Education Program Adult Treatment Panel III. Statistical tests were done in SPSS; relative frequency and percentages were used to present the variables that were categorical and statistically significant association was revealed through the relevant statistical tests.

Results: A total of 345 participants were included. The overall prevalence of metabolic syndrome was 34.2%. Central obesity, low high-density lipoprotein cholesterol, and elevated triglyceride levels were the most common components identified. The condition was more frequently observed among older adults and showed variation across demographic groups.

Conclusion: The metabolic syndrome is quite common in the rural communities of Karachi and indicates a growing cardiometabolic burden. Timely screening, community-based preventive programs, and targeted interventions in the health of the population are essential to reducing cardiovascular and metabolic morbidity in these groups in the future.

Keywords: Metabolic syndrome, prevalence, rural population, Karachi, cardiovascular risk factors, insulin resistance, obesity, dyslipidemia, hypertension, fasting blood glucose.

INTRODUCTION

Metabolic syndrome (MetS) is a complex of metabolic disorders that is characterized by central obesity, dyslipidemia, hypertension, and impaired glucose metabolism, which increase the risks of

cardiovascular disease and type 2 diabetes mellitus significantly.^[1] It has become one of the major concerns in terms of global public health, with its recent surge driven by sedentary living, dietary shifts, and urbanization, especially in the low- and middle-income nations, in particular.^[2] The current world

epidemiological estimates suggest that in 2023 there were about 1.54 billion adults who were burdened with MetS and this shows the growing global burden of the same disease. Across the various groups of people, the prevalence rates, depending on the diagnostic criteria and demographic factors, would range between 14% and almost 39%, depending on the population under study.^[3,4] The South Asian populations are deemed as particularly vulnerable because of genetic factors, current lifestyle habits, and socioeconomic injustices.^[5] The incidence of the metabolic risk factors like obesity and physical inactivity is gradually increasing in Pakistan. According to national surveillance data, the prevalence of overweight and obesity in the population is estimated to be about 25% and 10% respectively, thus being a significant contributor to cardiometabolic morbidity.^[6] Pakistan-related studies of recent also show a significant number of MetS even in supposedly healthy adults, with central obesity, low HDL-cholesterol, and high levels of triglycerides being the most common elements of it.^[7] Further evidence of a high rate of undiagnosed MetS in adults is provided by community-based research in Karachi, which justifies the necessity to monitor it at an early stage and prevent it specifically. Although there is increasing recognition of MetS, most of the epidemiological studies that have been carried out in Pakistan have been done on the urban areas, leaving the rural communities with inadequate data. The rural populations can also have unique risk profiles due to socioeconomic status, health literacy, healthcare services, and lifestyle differences.^[8,9] It is thus important to understand these differences in order to formulate effective public-health interventions. Hence, the current study aims to determine the prevalence of metabolic syndrome and its associated risk factors in a rural population of Karachi, Pakistan, to generate context-specific epidemiological data for healthcare planning.

MATERIALS AND METHODS

This was a cross-sectional study which was conducted in six months with the purpose of evaluating the prevalence of metabolic syndrome and its risk factors in a rural Pakistani population of Karachi. The study was conducted in Baqai fatima hospital which is a tertiary care facility and based at Baqai medical university located in rural communities.

The study population comprised adults aged 18 years and above residing in rural areas of Karachi who attended the hospital for routine medical checkups or non-emergency consultations during the study period.

The sample size was calculated using the standard formula for cross-sectional studies: $n = (Z^2 \times P \times (1-P))/d^2$, where $Z = 1.96$ for a 95% confidence interval, $P = 30\%$ expected prevalence, and $d = 5\%$ margin of error. The estimated sample size was 345

participants. A non-probability convenient sampling technique was employed to recruit eligible participants.

The study population included adults aged 18 years and above and who had permanent residence in rural Karachi and signed an informed consent. The pregnant women; people with endocrine disorders that have the potential to modify metabolic parameters (e.g., Cushing syndrome, hypothyroidism); those undergoing long-term corticosteroid regimens; as well as chronic diseases and malignancies with the potential to modify metabolic indices were not included in the analysis. The data were collected through a structured, pre-tested questionnaire, which was meant to measure demographic and clinical variables such as age, sex, occupation, smoking status and family tendency to chronic disease predisposition. Standardized anthropometric measurements were taken: the height and weight were measured, which made it possible to determine the body mass index, and the waist circumference was measured in accordance with the current protocol. The calibrated sphygmomanometer was used to measure systolic and diastolic blood pressure per the guidelines of the World Health Organization. Following an 8-12 hours fasting period in the venous blood, they were taken to the hospital lab where a test was performed to ascertain the levels of fasting plasma glucose, triglyceride level and high-density lipoprotein cholesterol levels in the blood.

Metabolic syndrome was defined according to the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) criteria, requiring the presence of at least three of the following components: abdominal obesity (waist circumference >102 cm in men and >88 cm in women), triglycerides ≥ 150 mg/dL, HDL cholesterol <40 mg/dL in men and <50 mg/dL in women, blood pressure $\geq 130/85$ mmHg or use of antihypertensive medication, and fasting blood glucose ≥ 100 mg/dL or treatment for diabetes. The primary outcome variable was the presence of metabolic syndrome, while independent variables included demographic characteristics, anthropometric measures, blood pressure, and biochemical parameters.

All the data gathered were recorded and analysed with the help of IBM SPSS Statistics version 30. Demographic and clinical variables were summarised using descriptive statistics; continuous variables were summarised using the mean and standard deviation while the frequencies and percentages were used to summarise categorical variables. The Chi-square test was used to test associations of metabolic syndrome with categorical variables. Continuous variables were compared between groups using independent t-tests or one-way ANOVA. To see the independent predictors of metabolic syndrome, binary logistic regression was carried out. The p-value below 0.05 was taken as statistical significance. The study was also commenced with ethical approval of the institutional review board of Baqai medical university. Informed consent was taken in writing.

The study ensured the participants confidentiality and anonymity and all the procedures were performed in accordance with the traditional ethical standards of human research.

RESULTS

A total of 345 participants were included in the final analysis. The mean age of the study population was 44.8 ± 11.6 years. Males constituted 180 (52.2%) participants, while 165 (47.8%) were females. Participants aged ≥ 40 years accounted for 205 (59.4%) of the sample, whereas 140 (40.6%) were below 40 years of age [Table 1].

Metabolic syndrome, as defined by the NCEP ATP III criteria, was identified in 118 participants, yielding an overall prevalence of 34.2%. Among the individual components, central obesity was the most frequently observed abnormality, present in 190 (55.1%) participants. Low high-density lipoprotein cholesterol levels were noted in 175 (50.7%) individuals, followed by elevated serum triglycerides in 160 (46.4%). Hypertension was observed in 145 (42.0%) participants, while raised fasting blood glucose levels were present in 130 (37.7%) individuals [Table 2].

Gender-wise distribution showed that metabolic syndrome was present in 68 (37.8%) males and 50 (30.3%) females. A higher frequency of metabolic syndrome was observed among participants aged ≥ 40 years compared to those under 40 years of age [Table 3]. The distribution of metabolic syndrome components according to age and gender is summarized in [Table 3].

[Figure 1] illustrates the overall prevalence of metabolic syndrome in the study population. [Figure 2] demonstrates the relative frequency of individual metabolic syndrome components among participants.

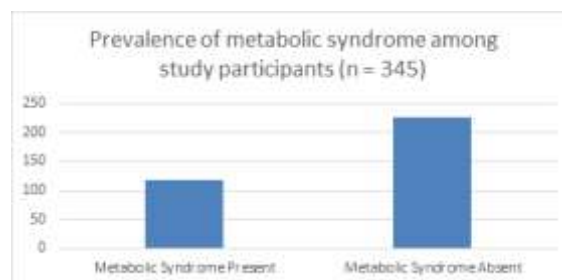


Figure 1: Prevalence of metabolic syndrome among study participants (n = 345), showing the proportion of individuals meeting the NCEP ATP III diagnostic criteria.

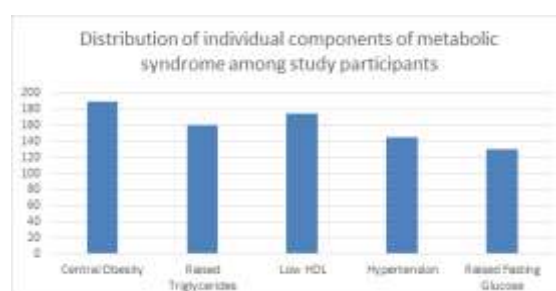


Figure 2: Distribution of individual components of metabolic syndrome among study participants, including central obesity, raised triglycerides, low HDL cholesterol, hypertension, and elevated fasting blood glucose.

Table 1: Demographic Characteristics

Variable	n	%
Male	180	52.2
Female	165	47.8
Age <40 years	140	40.6
Age ≥ 40 years	205	59.4

Table 2: Components of Metabolic Syndrome

Component	n	%
Metabolic Syndrome Present	118	34.2
Central Obesity	190	55.1
Raised Triglycerides	160	46.4
Low HDL	175	50.7
Hypertension	145	42.0
Raised Fasting Glucose	130	37.7

Table 3: Distribution by Age and Gender

Variable	MetS Present n (%)	MetS Absent n (%)	Total
Male	68 (37.8%)	112 (62.2%)	180
Female	50 (30.3%)	115 (69.7%)	165
Age <40	32 (22.8%)	108 (77.2%)	140
Age ≥ 40	86 (41.9%)	119 (58.1%)	205

DISCUSSION

The current research has found significant burden of metabolic syndrome within a rural population in Karachi that supports the rising metabolic syndrome as a significant problem among the population in

Pakistan. Similar results have been presented in more recent Pakistani and other regional studies, in which the prevalence of metabolic syndrome has been reported between about 20% and 39% in community-based populations with higher prevalence in some of the high-risk groups.^[10,11] Most recent meta-analyses

in supposedly healthy Pakistani adults showed a pooled prevalence of 28.8% with such a remarkable geographical and diagnostic variation across the studies.^[12] The same investigation in health care workers and other adult groups has also indicated a high rate of metabolic syndrome with low levels of HDL cholesterol and excessive waist circumference often coming out as the leading features.^[13,14] Such trends are in line with the existing literature and indicate the current epidemiological shift among the South Asian populations. The clustering of the metabolic abnormalities as observed can be attributed to several biological processes. The metabolic syndrome has insulin resistance as the central pathophysiological factor that contributes to the failure to metabolize glucose, dyslipidemia and hypertension.^[15] Further contribution of adipose tissue dysfunction comes in the form of dysregulated adipokine release, mitochondrial changes, and systemic inflammatory changes.^[16] Other factors that have been linked to the development of metabolic syndrome to cardiovascular disease and type 2 diabetes include chronic low-grade inflammation, oxidative stress and endothelial dysfunction.^[17,18] Molecular evidence in recent years indicates that an imbalance of gut microbiota and epigenetics can also affect the cardiometabolic risk phenotype.^[19] All these mechanisms can be seen to explain the high prevalence of obesity, dyslipidemia, and glucose abnormalities on a population level. The burden of metabolic syndrome among rural populace must have been largely influenced by socio-demographic and environmental circumstances. Despite rural populations showing greater exercise, dietary habits, lack of healthcare accessibility, and health literacy may lead to undiagnosed cardiometabolic risk although rural population exhibits greater physical activity traditionally.^[20] Urbanization, sedentary lifestyles and nutritional changes also play a major role in increasing diabetes and obesity in Pakistan, and that further increases the chances of metabolic syndrome even in the non-urban environment.^[21] Other studies of regional differences have revealed similar rural-urban variations, in which the prevalence of metabolic syndrome varied according to lifestyle and socioeconomic risk factors.^[22] The strong points in this study are its community-based design, standardization of diagnostic criteria or one of its strengths is a check of several metabolic components done through objective biochemical and clinical results. The emphasis on a rural population bridges a significant gap in the literature of evidence about Pakistan, in which the greatest portion of epidemiological studies has traditionally focused on urban cohorts. There are, however, some limitations that must be considered. This cross-sectional study design cannot be used to cause risks factors and metabolic syndrome. The fact that a single-center sampling method was used can limit the ability to apply the results to other rural areas. Also, there was not a comprehensive quantification of behavioral variables (dietary intake and physical activity) and

biochemical variables were measured only in one particular instance. Irrespective of these shortcomings, implications of the findings are of significance to both clinical and public health. Detection of metabolic syndrome in the community level at an early stage is vital in preventing cardiovascular disease and diabetes. The cardiometabolic burden among the rural populations can be reduced substantially through targeted screening programs, lifestyle modification measures, and interventions based on primary care. Moreover, longitudinal and multi-center studies in the future are necessary in order to investigate causal pathways, test preventive interventions, and create risk-prediction models specific to the populations of South Asia.

CONCLUSION

The problem of metabolic syndrome among rural population under discussion is a serious and growing health issue, which highlights the omnipresent shift to non-communicable diseases in the low- and middle-income settings. The presented empirical results highlight the urgent need to identify those who are at risk early and to implement systematic metabolic screening into the primary care environments. Prevention of cardiovascular and metabolic sequela in the long-term is impossible without augmentation of preventive measures focusing on lifestyle change, community awareness, and risk determinant control. Future multi-centric longitudinal studies are justified to better clarify the risk pathways and also enable designing specific interventions to be applied in rural populations to improve their health.

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