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Research Article

Association of Genetic Predisposition, Dietary Habits, and Psychological Factors with Metabolic Syndrome in Sedentary Adults in Kochi

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ABSTRACT

Background: Metabolic Syndrome (MetS) is a multifactorial condition influenced by both genetic predisposition and lifestyle-related risk factors. **Objectives:** This cross-sectional study investigated the prevalence and determinants of MetS among 500 sedentary working adults aged 30- 59 years in Kochi, Kerala. **Materials and Methods:** Data were collected on socio-demographic variables, family history, dietary behaviors, cooking practices, and psychological status, with MetS diagnosed using NCEP ATP III criteria. **Results:** The results showed that the prevalence of MetS was significantly higher (p=0.006) among females (63.4%) compared to males (51.0%). A positive family history of metabolic disorders emerged as a strong determinant, with maternal (62.1%, p<0.001), paternal (58.7%, p=0.001), sibling, and grandparental histories showing significant associations. Among dietary factors, frequent consumption of fast foods (54.9%, p=0.003), carbonated drinks (29.7%, p=0.001), and fried foods (45.1%, p=0.008) were strongly associated with MetS, while cooking method, type of oil used, and meal frequency showed no significant associations. Anxiety was the only psychological factor significantly associated with MetS (p=0.010), whereas depression and stress did not show relation with statistical significance. **Conclusion:** The findings indicate that both hereditary factors and modifiable lifestyle behaviors including diet and psychological stress collectively influence the risk of developing Metabolic Syndrome (MetS). These results highlight the need for integrated preventive strategies involving genetic risk screening, dietary interventions, and mental health management to curb the rising burden of MetS in sedentary populations.

Keywords: Genetic Predisposition, Metabolic Syndrome, Risk factors, Sedentary Adults.

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INTRODUCTION

Hyperglycemia, insulin resistance, hypertension, dyslipidemia, and central obesity are all part of the Metabolic Syndrome (MetS), a group of risk factors for cardiovascular disease and type 2 diabetes that is becoming more and more common worldwide and is greatly influenced by lifestyle, diet, and genetics (Şenyiğit, 2025). The global prevalence of Metabolic Syndrome (MetS) is estimated to range between 20% and 30%, with a notable increase in low- and middle-income countries attributed to urbanization, dietary changes, and sedentary lifestyles. This syndrome, characterized by a cluster of metabolic risk factors, poses significant health risks, including heightened chances of cardiovascular diseases and type 2 diabetes (Patial *et al.*, 2024). In India, the prevalence of metabolic syndrome in multisite showed to be 33.3% in men and 40.4% in women using harmonized Asian-specific criteria (Deedwania *et al.*, 2014). The prevalence was lower when using modified Adult Treatment Panel-3 (ATP-3) criteria, at 23.9% for men and 34.5% for women (Deedwania *et al.*, 2014). Similarly, gender distribution of MetS showed that females had a higher prevalence (35%) when compared to males (26%).

The Metabolic Syndrome (MetS) has a multifactorial etiology, influenced by both genetic and environmental factors. Family and twin studies support the role of hereditary predisposition, indicating that a family history of diabetes, hypertension, or cardiovascular disease significantly elevates the risk of developing MetS. (Rana *et al.*, 2022). Genetic variations significantly influence body weight and obesity risk, with certain genes affecting food intake and energy balance. These genetic predispositions can be exacerbated by unhealthy dietary patterns, such as high intake of sugar-sweetened beverages and fried foods, which have been shown to modify genetic associations with obesity and related metabolic traits (Wang & Wang, 2020).

Kerala, despite being recognized for remarkable achievements in literacy and health awareness, is now witnessing a concerning

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rises in the prevalence of Metabolic Syndrome (MetS), particularly among sedentary middle-aged workers. This trend reflects the growing impact of sedentary occupations, changing dietary habits, and genetic predisposition, which often outweigh the benefits of awareness alone. Several studies have reported that the prevalence rates of MetS in Kerala range from 14% to 61%, depending on diagnostic criteria, highlighting the seriousness of the issue (Mini *et al*., 2019; Srinivasan *et al*., 2016; Nair *et al*., 2017).

In this context, the present study was undertaken to evaluate the influence of dietary patterns, genetic predisposition, and psychological factors on the prevalence of MetS among sedentary working adults in Kochi Municipal Corporation, Kerala.

OBJECTIVES

- To find out the prevalence of metabolic syndrome among sedentary working adults.
- To identify genetic and dietary risk factors and evaluate the contributing to the prevalence of metabolic syndrome among sedentary working adults.
- To evaluate the association between familial genetic predisposition, dietary patterns, and psychological factors with the prevalence of metabolic syndrome.

METHODOLOGY

A cross-sectional study was conducted among sedentary adults within Kochi Municipal Corporation, Kerala. A total of 500 adults aged 30-59 years engaged in sedentary occupations participated in the study.

Inclusion Criteria

The study included adults aged between 30-59 years who were engaged in a sedentary lifestyle, defined as occupations or daily routines characterized by prolonged sitting and minimal physical activity. Only participants who were apparently healthy and willing to provide informed consent were enrolled for the study.

Exclusion Criteria

Individuals with a prior diagnosis of chronic illnesses that could affect metabolic outcomes were excluded. Pregnant and lactating women, adults outside the specified age range, moderate and heavy workers, and those unwilling to participate or unable to provide complete anthropometric and biochemical data were also excluded.

MetS was diagnosed based on NCEP ATP III criteria (Goel *et al*., 2024), which require the presence of three or more of the following:

1. Waist circumference >102 cm (men) or >88 cm (women),
2. Triglycerides ≥150 mg/dL,
3. HDL cholesterol <40 mg/dL (men) or <50 mg/dL (women),
4. Blood pressure ≥130/85 mmHg,
5. Fasting plasma glucose ≥100 mg/dL.

Data collection was carried out using a structured questionnaire that included information on demographics, dietary patterns, family medical history, lifestyle factors, and psychological stress. Depression, anxiety, and stress were assessed using the DASS-21 tool.

An Indian study by Sharma demonstrated through confirmatory factor analysis that the DASS-21 effectively measures general psychological distress, with strong correlations among its subscales (Sharma *et al*., 2020).

Data was analyzed using descriptive statistics and chi-square test, with significance set at $p<0.05$.

RESULTS

Prevalence of Metabolic Syndrome

Prevalence of Metabolic Syndrome across Gender and Age

Among 500 sedentary working adults aged 30-59 years, this analysis examines how occupational inactivity, combined with biological and lifestyle factors, influences MetS prevalence across genders, using NCEP ATP III diagnostic criteria. Gender wise distribution of metabolic syndrome is presented in Table 1.

Out of 500 participants, 293 (58.6%) were found to have MetS while 207 (41.4%) were not having the condition. Among males (n=194), 99 (51.0%) had MetS and 95 (49.0%) were not having MetS. In contrast, among females (n=306), a higher proportion, 194 (63.4%), had MetS while 112 (36.6%) were without the condition. The association between gender and MetS was statistically significant (p=0.006), indicating that female gender showed a higher prevalence of MetS compared to males in this sedentary working population.

The prevalence of MetS showed a rising trend with advancing age among sedentary working adults. It is clear from Table 2 that in the 30-34 years age group, 47.7% were affected, increasing to 53.8% in the 35-39 years group. Beyond 40 years, prevalence consistently exceeded 58%, with 60.5% in 40- 44 years, 60.6% in 45- 49 years, 58.8% in 50- 54 years, and 60.5% in 55-59 years. When grouped, the overall prevalence was 50.8% among adults below 40 years compared to 60.1% among those aged 40 years and above, indicating that nearly three out of five older sedentary workers were affected by MetS. Considering the entire study population aged 30-59 years, the overall prevalence was 58.6%. The percentage of individuals without MetS consistently declined

as age advanced, dropping from 52.3% in the youngest group to around 39.5% in older groups.

Although the age-related differences in this study were not statistically significant (p=0.696), the trend clearly indicates greater vulnerability with advancing age.

Influence of Dietary Habits on MetS

Dietary habits play a crucial role in the development of Metabolic Syndrome (MetS). To assess this, the association between the frequency of consuming fast foods, fried items, carbonated drinks, and sweets with the prevalence of MetS was examined and presented in Table 3 with visual representations provided in Figures 1-4.

Dietary patterns showed a significant association with MetS. Individuals consuming fast food more than once per week had a higher prevalence of MetS (54.9%, p=0.003). Similarly, frequent intake of fried foods was linked with increased prevalence (45.1%, p=0.008). The most striking association was with carbonated drink consumption, where prevalence reached 29.7% and the relationship was highly significant (p=0.001). Although sweet consumption more than once per week showed a trend toward higher MetS prevalence, the association did not reach statistical significance (p=0.058).

Dietary Behaviors

The following Table 4 and Figure 5 illustrated the distribution of Metabolic Syndrome (MetS) among participants according to their type of diet. The comparison between individuals with and without MetS highlights dietary patterns, with the majority of both groups reporting a non-vegetarian diet, followed by smaller proportions adhering to vegetarian, lacto-vegetarian, and Ovo-vegetarian.

The prevalence of Metabolic Syndrome (MetS) was significantly associated with type of diet (p=0.025). Among participants with MetS, the majority were non-vegetarians (185, 89.4%), followed by vegetarians (17, 8.2%), lacto-vegetarians (4, 1.9%), and Ovo-vegetarians (1, 0.5%). In comparison, among those without MetS, non-vegetarians also predominated (277, 94.5%), with vegetarians (13, 4.4%), Ovo-vegetarians (3, 1.0%), and no lacto-vegetarians (0, 0.0%). Although non-vegetarian diets were predominant in both groups, the significant association (p=0.025) suggests that diet type may influence MetS prevalence in this population, where non-vegetarian eating patterns are culturally common.

Table 5 showed the distribution of cooking methods was similar between participants with and without MetS (p=0.715) as also depicted in Figures 6-8. Among those with MetS, 11.1% used boiling, 9.7% used steaming, 9.2% used frying, 9.2% used roasting, and 60.9% used combination methods. In comparison, among participants without MetS, 10.9% used boiling, 8.5% used steaming, 8.9% used frying, 6.1% used roasting, and 65.5% used combination methods.

The type of cooking oil used was also not significantly associated with MetS (p=0.082). Coconut oil was the most used in both groups (71.5% with MetS vs. 64.5% without MetS), followed by sunflower oil (19.8% vs. 28.3%), palm oil (3.9% vs. 1.7%), and rice bran oil (4.8% vs. 5.5%).

The number of meals per day did not show a significant association with MetS (p=0.272). Most participants in both groups consumed three meals per day (69.8% with MetS vs. 70.0% without MetS), followed by four meals (26.9% vs. 26.6%), two meals (3.0% vs. 2.9%), and five meals (1.0% vs. 0.5%).

Table 1: Gender wise distribution.

Gender	MetS Present (n, %)	MetS Absent (n, %)	Total (n)	*p*-value
Male	99 (51.0%)	95 (49.0%)	194	
Female	194 (63.4%)	112 (36.6%)	306	
Total	293 (58.6%)	207 (41.4%)	500	0.006*

Significance level: $p<0.05$ was considered statistically significant.

Table 2: Age wise distribution. Age-specific prevalence patterns of MetS were examined to assess how advancing age influences metabolic risk among sedentary adults.

Age group (years)	MetS Present (n, %)	MetS Absent (n, %)	Total (n)	*p*-value
30-34	21 (47.7%)	23 (52.3%)	44	
35- 39	21 (53.8%)	18 (46.2%)	39	
40- 44	23 (60.5%)	15 (39.5%)	38	
45- 49	40 (60.6%)	26 (39.4%)	66	
50- 54	50 (58.8%)	35 (41.2%)	85	
55- 59	138 (60.5%)	90 (39.5%)	228	
Total	293 (58.6%)	207 (41.4%)	500	0.696

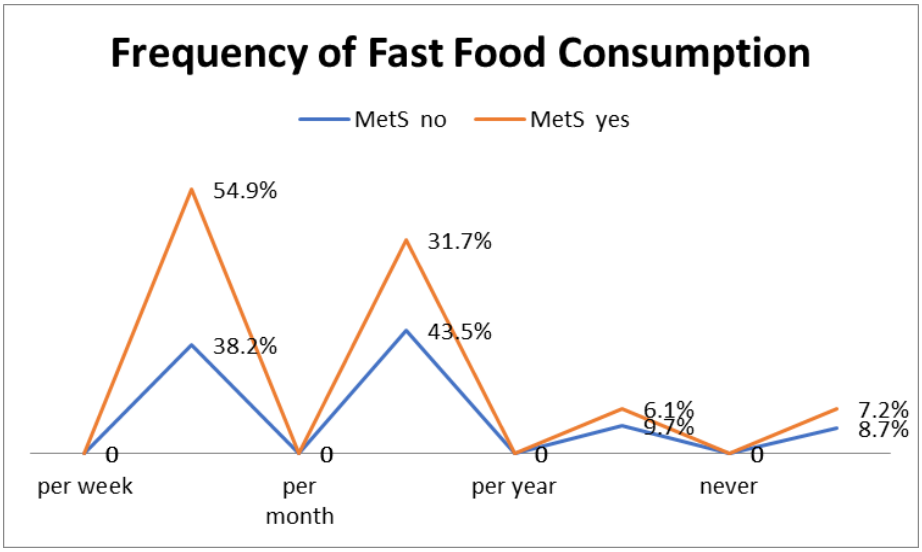

Figure 1: Frequency of Fast Food Consumption.

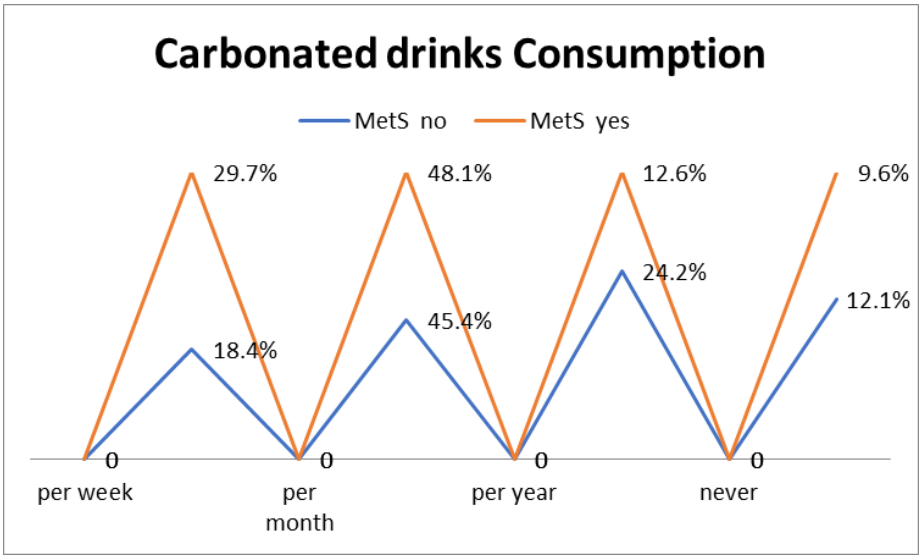

Figure 2: Frequency of Carbonated drinks Consumption.

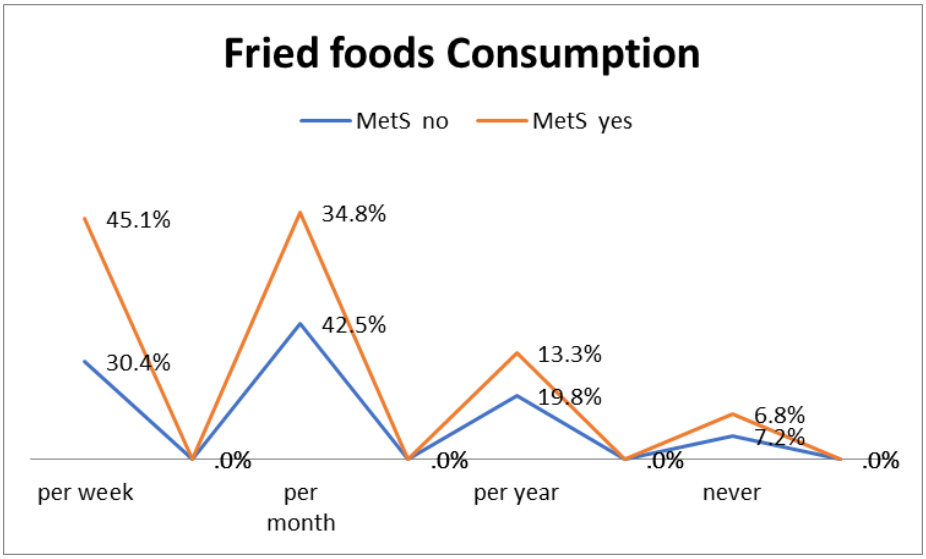

Figure 3: Frequency of Fried Foods consumption.

The study result showed that there were no significant differences in cooking methods, type of oil, or meal frequency between individuals with and without MetS, suggesting that these dietary practices were not associated with MetS prevalence in this population.

Genetic Risk Factors

The following Table 6 represents the influence of genetic risk factors on the prevalence of Metabolic Syndrome (MetS). The analysis examined the association of family history, including parents, siblings, and grandparents, with MetS, highlighting the role of hereditary predisposition in its occurrence.

Family history was significantly associated with the prevalence of Metabolic Syndrome (MetS) for several relatives. Among participants with MetS, the majority had no affected father (172, 58.7%), mother (182, 62.1%), brother (252, 86.0%), sister (262, 89.4%), paternal grandparents (259, 88.4%), and maternal grandparents (256, 87.4%). However, a notable proportion of participants with MetS did report a positive family history: father (121, 41.3%), mother (111, 37.9%), brother (41, 14.0%), sister (31, 10.6%), paternal grandparents (34, 11.6%), and maternal grandparents (37, 12.6%), all showing significant associations with MetS ($p \leq 0.002$). Family history of son (17, 5.8%) and daughter (14, 4.8%) was low and not significantly associated with MetS. Overall, the results indicate that MetS prevalence is linked to a positive family history in first- and second-degree relatives, while the majority of participants still did not report affected family members.

Table 3: Influence of Dietary Habits on MetS. The association between unhealthy dietary habits such as fast food, fried foods, carbonated drinks, and sweets and the prevalence of MetS was evaluated.

Dietary Habit	Prevalence of MetS (%)	*p*-value
Fast food (>1/week) Consumption	54.9	0.003
Carbonated drinks (>1/week) Consumption	29.7	0.001
Fried foods (>1/week) Consumption	45.1	0.008
Sweet consumption (>1/week) Consumption	44.0	0.058

The present study found a significant association between family history and the prevalence of Metabolic Syndrome (MetS), with a notable proportion of participants reporting affected fathers, mothers, siblings, and grandparents. While the majority did not report a positive family history, these findings align with the understanding that genetic factors play an important role in MetS.

Association of Depression, Anxiety and Stress and MetS

Table 7 showed the association of psychological factors-depression, anxiety, and stress-with Metabolic Syndrome (MetS), as assessed using the Depression, Anxiety, and Stress Scale (DASS-21). The comparison between participants with and without MetS provides insights into the potential role of psychological distress in the development and maintenance of the condition.

Among the psychological variables examined, anxiety was significantly associated with metabolic syndrome (MetS) ($p=0.010$), while depression ($p=0.140$) and stress ($p=0.345$) were not. Participants with MetS had a higher proportion of moderate (93, 31.7%) and extremely severe anxiety (129, 44.0%) compared to those without MetS (moderate 39, 18.8%; extremely severe 98, 47.3%). In contrast, the distribution of depression and stress levels was similar between participants with and without MetS, indicating no significant association. These findings suggest that anxiety may be more closely linked to MetS than depression or stress in this population.

DISCUSSION

The prevalence of Metabolic Syndrome (MetS) among Asian Indians, particularly in urban Eastern India, is alarmingly high, with significant risk factors identified. A community study revealed an overall prevalence of 33.5%, with higher rates in females (42.3%) compared to males (24.9%) (Prasad *et al*., 2012). Another study reported a prevalence of 62.6% in the study group, with a higher occurrence observed among older and obese women. Consistent with this study finding, national-level evidence also indicates a higher prevalence of MetS among women. In a study in rural Kerala indicated a prevalence of 69.66% among females, highlighting a concerning trend in the populations (Nanda Kumar *et al*., 2011) .

Dietary pattern-based research indicates that frequent intake of fast foods, fried foods, and carbonated beverages is closely linked

Table 4: Effect of Type of Diet on MetS. The type of diet compared between participants with and without MetS.

Diet Type	MetS Present (*n*=207)	MetS Absent (*n*=293)	Total (*n*=500)
Non-vegetarian	185 (89.4%)	277 (94.5%)	462 (92.4%)
Vegetarian	17 (8.2%)	13 (4.4%)	30 (6.0%)
Lacto-vegetarian	4 (1.9%)	0 (0.0%)	4 (0.8%)
Ovo-vegetarian	1 (0.5%)	3 (1.0%)	4 (0.8%)
Total	207 (100%)	293 (100%)	500 (100%)

Table 5: Effect of Dietary Behavior on MetS. To assess the role of dietary behaviors such as cooking methods, type of oils and meal frequency were compared between participants with and without MetS.

Variable	MetS Present (n, %)	MetS Absent (n, %)	*p*-value
Cooking method			0.715
Boiling	23 (11.1%)	32 (10.9%)	
Steaming	20 (9.7%)	25 (8.5%)	
Frying	19 (9.2%)	26 (8.9%)	
Roasting	19 (9.2%)	18 (6.1%)	
Combination methods	126 (60.9%)	192 (65.5%)	
Type of oil			0.082
Coconut oil	148 (71.5%)	189 (64.5%)	
Palm oil	8 (3.9%)	5 (1.7%)	
Sunflower oil	41 (19.8%)	83 (28.3%)	
Rice bran oil	10 (4.8%)	16 (5.5%)	
Meal pattern/day			0.272
2 meals	6 (3.0%)	7 (2.9%)	
3 meals	277 (69.8%)	145 (70.0%)	
4 meals	114 (26.9%)	55 (26.6%)	
5 meals	4 (1.0%)	1 (0.5%)	

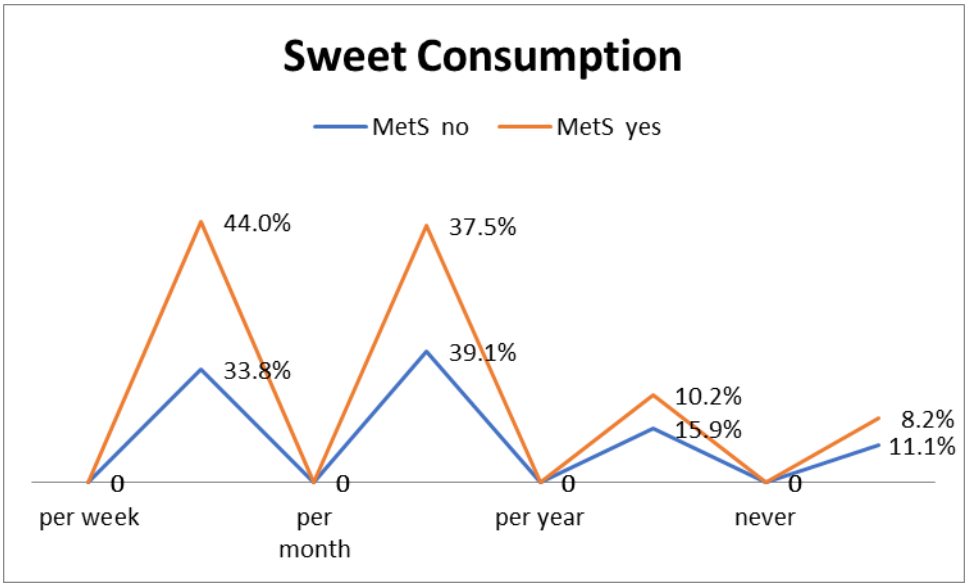

Figure 4: Frequency of Sweet consumption.

to the development of metabolic syndrome, particularly due to the global rise in obesity and related chronic diseases. This dietary transition, marked by increased dependence on energy-dense fast foods and sugar-rich soft drinks, has been recognized as a major contributor to obesity and the growing burden of metabolic syndrome (Puri & Anumakonda, 2024).

The current study results are supported by other studies showing that lacto-vegetarian and semi-vegetarian diets were linked to lower diabetes prevalence (0.9% and 0.7%, respectively) compared to non-vegetarians (Agrawal *et al.*, 2014).

Previous research estimates that the heritability of MetS exceeds 50%, and evidence from family and twin studies, linkage analyses, and genome-wide association studies further highlights the contribution of inherited factors to its pathogenesis (Yousuf & Ganie, 2024).

The study found that anxiety, but not depression or stress, was significantly associated with Metabolic Syndrome (MetS), with higher anxiety levels observed in participants with MetS. This aligns with previous research linking anxiety symptoms to increased waist circumference, a key component of MetS,

Table 6: Genetic Risk Factors on MetS. The association of family history-including parents, siblings, and grandparents-with the presence of MetS was analyzed to evaluate genetic predisposition.

Relation	MetS Present (*n*=207)	MetS Absent (*n*=293)	*p*-value
Father			0.001*
Yes	121 (41.3%)	118 (57.0%)	
No	172 (58.7%)	89 (43.0%)	
Mother			0.001*
Yes	111 (37.9%)	116 (56.0%)	
No	182 (62.1%)	91 (44.0%)	
Brother			0.001*
Yes	41 (14.0%)	53 (25.6%)	
No	252 (86.0%)	154 (74.4%)	
Sister			0.002*
Yes	31 (10.6%)	43 (20.8%)	
No	262 (89.4%)	164 (79.2%)	
Paternal Grandparents			0.001*
Yes	34 (11.6%)	55 (26.6%)	
No	259 (88.4%)	152 (73.4%)	
Maternal Grandparents			0.001*
Yes	37 (12.6%)	55 (26.6%)	
No	256 (87.4%)	152 (73.4%)	
Son			0.104
Yes	17 (5.8%)	20 (9.7%)	
No	276 (94.2%)	187 (90.3%)	
Daughter			0.078
Yes	14 (4.8%)	18 (8.7%)	
No	279 (95.2%)	189 (91.3%)	

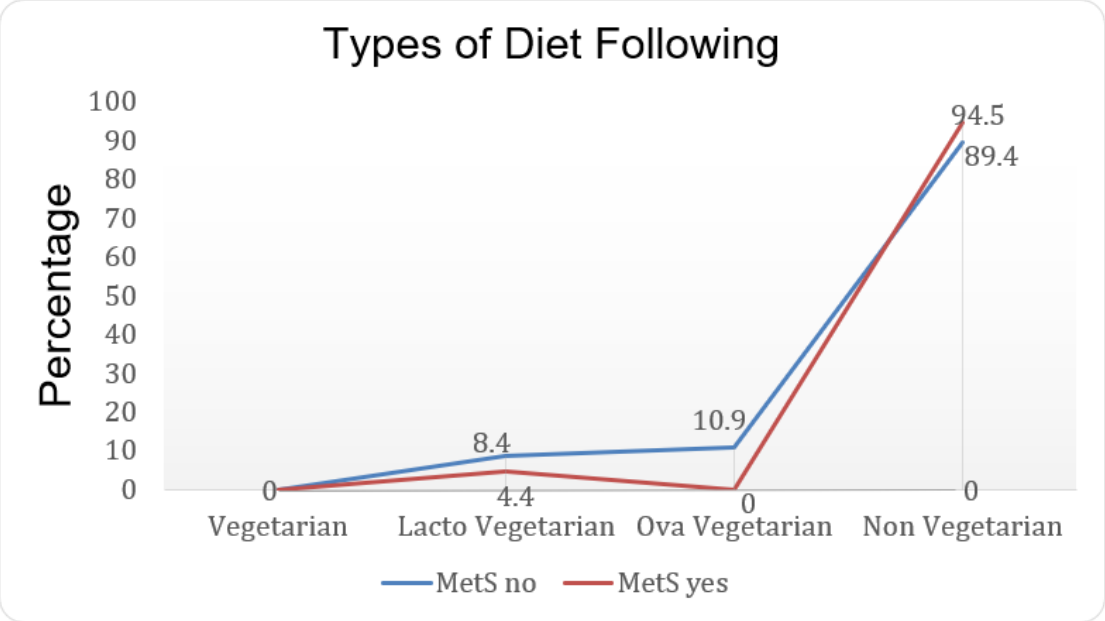

Figure 5: Type of Diet Following.

Table 7: Association of Depression, Anxiety and Stress and MetS. To explore psychological correlations, levels of depression, anxiety, and stress were compared between participants with and without MetS.

Category	MetS Present (*n*=293)	MetS Absent (*n*=207)	*p*-value
Depression			0.140
Normal	67 (22.9%)	55 (26.6%)	
Mild	27 (9.2%)	8 (3.9%)	
Moderate	119 (40.6%)	84 (40.6%)	
Severe	55 (18.8%)	36 (17.4%)	
Extremely severe	25 (8.5%)	24 (11.6%)	
Anxiety			0.010*
Normal	34 (11.6%)	40 (19.3%)	
Mild	9 (3.1%)	6 (2.9%)	
Moderate	93 (31.7%)	39 (18.8%)	
Severe	28 (9.6%)	24 (11.6%)	
Extremely severe	129 (44.0%)	98 (47.3%)	
Stress			0.345
Normal	155 (52.9%)	92 (44.4%)	
Mild	18 (6.1%)	14 (6.8%)	
Moderate	45 (15.4%)	42 (20.3%)	
Severe	69 (23.5%)	52 (25.1%)	
Extremely severe	6 (2.0%)	7 (3.4%)	

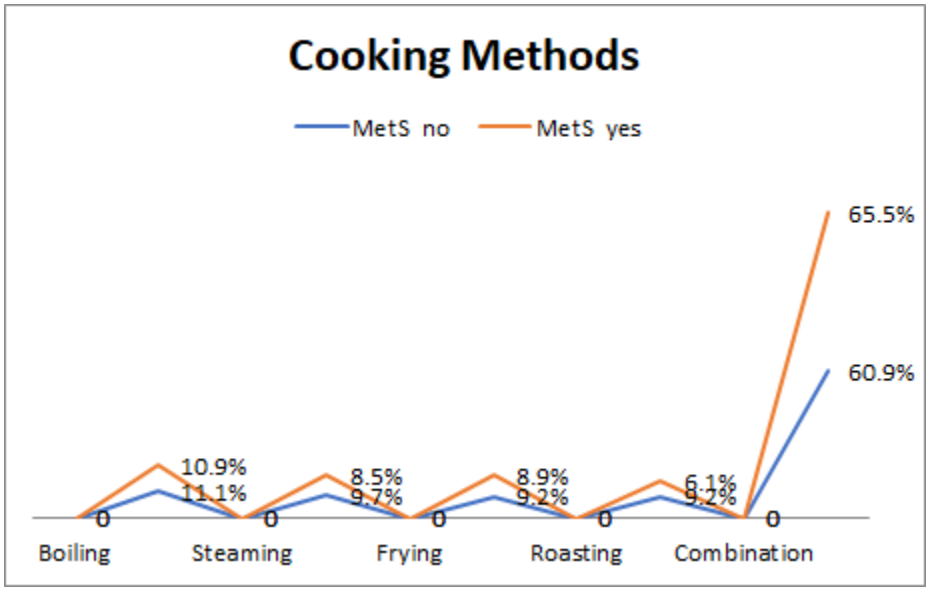

Figure 6: Type of Cooking methods. included in discussion.

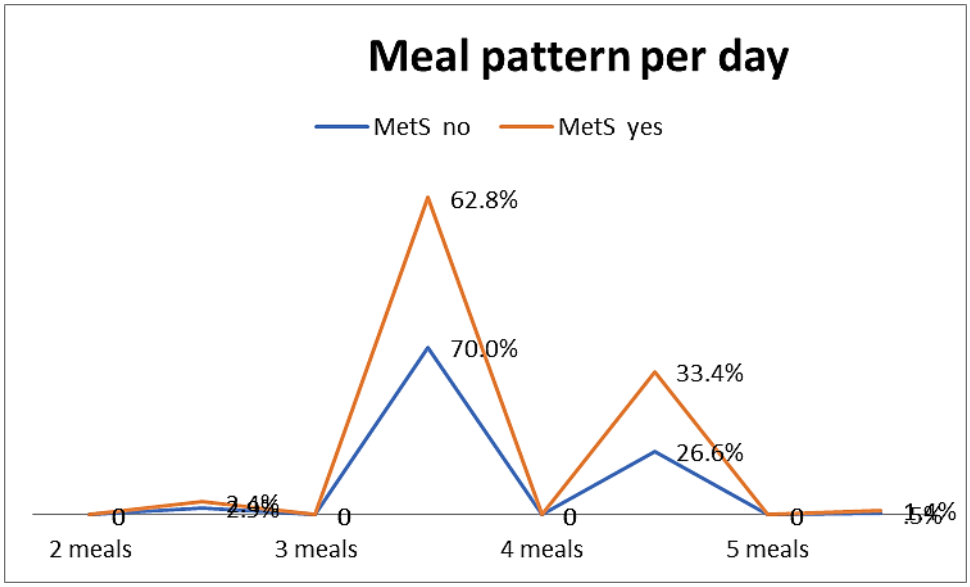

Figure 7: Type of Meal Pattern per Day. included in discussion.

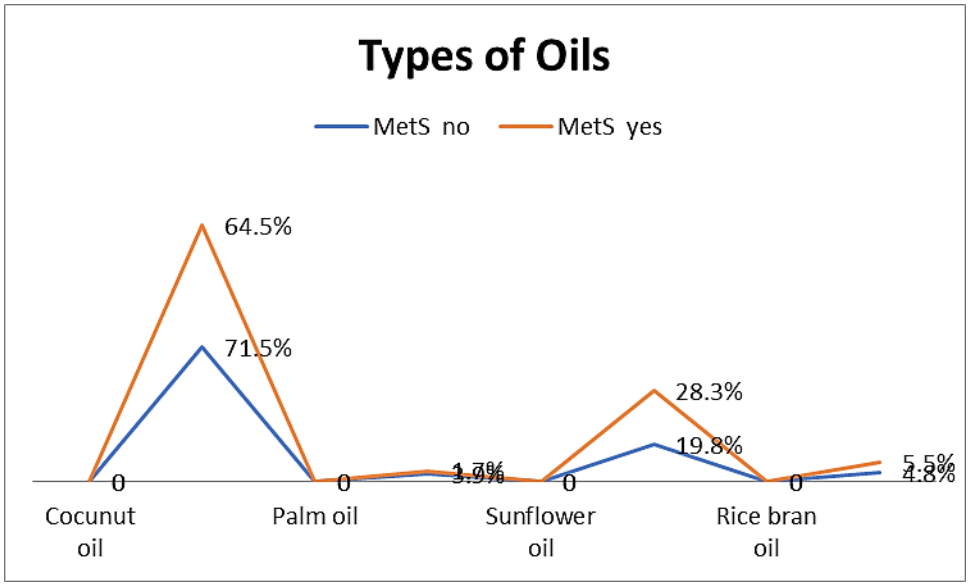

Figure 8: Type of Cooking Oils. included in discussion.

and shows that depressive and anxious-depressive symptoms are inversely associated with educational level. These findings underscore the need for integrated clinical management of psychological and metabolic conditions (Rioli *et al*., 2023; Krishnamoorthy *et al*., 2020; Sharma *et al*., 2016).

CONCLUSION

This study highlights that metabolic syndrome in sedentary working adults is shaped by a complex interplay of genetics, lifestyle, and mental health. A strong family history, particularly among parents and close relatives, emerged as a key predictor of risk. Unhealthy eating patterns, such as frequent consumption of fast foods, fried items, and carbonated drinks, further intensified this risk, while routine dietary behaviors like meal frequency or cooking methods appeared less influential. Anxiety also stood out as an important psychological factor, emphasizing the need to view metabolic health not just through a physical assessment but also through the mental well-being of individuals.

Overall, the findings reinforce the need for holistic interventions combining genetic screening, targeted dietary counseling, and psychological support. Gender-sensitive and culturally tailored public health strategies are essential to address the high prevalence of metabolic syndrome in Kerala's sedentary working population.

ACKNOWLEDGEMENT

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ABBREVIATIONS

MetS: Metabolic Syndrome; **DASS-21:** Depression, Anxiety, and Stress Scale.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ETHICAL APPROVAL AND CONSENT TO PARTICIPAT

The study was approved by the Institutional Ethics Committee.

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