RESEARCH PAPER

Impact Of Lifestyle Modifications On The Management Of Metabolic Syndrome In Adults With Obesity

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ABSTRACT

Metabolic syndrome (MetS) is marked by a cluster of interconnected health risks, including excessive fat accumulation around the abdomen, irregular lipid profiles, hypertension, and increased fasting blood glucose levels. Collectively, these conditions increase the risk of cardiometabolic disease and insulin-resistant diabetes. This study focused on assessing the impact of a nutrition intervention program designed for obese adult men with MetS in Coimbatore District, Tamil Nadu. A total of 100 obese men aged 36–55 years were selected from the outpatient unit of PSG Hospital. Data on socioeconomic background, anthropometric measurements, biochemical markers, and dietary habits were also collected. The intervention involved providing nutrition education through personalized counseling, informational pamphlets, and PowerPoint presentations focusing on balanced diets and lifestyle modifications. The effectiveness of the program was evaluated by comparing outcomes before and after the intervention. Ethical clearance was granted, and all participants provided consent beforehand. At baseline, 70% of the participants exhibited abdominal obesity (mean waist circumference: 102.4 cm), 65% had dyslipidemia, 55% had fasting glucose levels ≥100 mg/dL, and 60% had hypertension. Following the intervention, significant improvements were observed, including a 4.2% reduction in waist circumference, 5.8% decrease in fasting glucose levels, and 6.5% reduction in triglyceride levels. Furthermore, 40% of the participants made healthier food choices and 25% increased their physical activity. These findings highlight the positive impact of targeted nutrition education on the key health parameters associated with MetS. This study underscores the need to integrate nutrition education into public health strategies to combat the increasing prevalence of MetS and related lifestyle disorders in India.

Keywords: Metabolic Syndrome, Lifestyle Modification, Nutrition Interventions.

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1. INTRODUCTION

MetS is a critical public health challenge, especially among obese individuals, owing to its close

connection with non-infectious diseases, such as cardiovascular disease, hyperglycemia disorder, and apoplexy. India is a challenge for both infectious and chronic diseases, with chronic conditions contributing to approximately 5.8 million deaths each year (WHO, 2015)**.** In India, nearly 25% of individuals face the threat of early mortality due to chronic diseases before the age of 70 years, emphasizing the need for strong control measures and proactive healthcare interventions **(Health and Family Welfare Department, 2024)**. MetS, defined as adiposity, insulin dysfunction, increased arterial pressure, and lipid imbalance, significantly increases the risk of long-term disease progression. The modified National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) criteria were used to diagnose MetS. However, studies have suggested that these guidelines may underestimate the true burden in Asian-Indian populations owing to genetic predisposition and lifestyle factors **(Misra *et al.*, 2019).** The rising occurrence of MetS in India is primarily driven by rapid urbanization, physical inactivity, poor dietary habits, and a shift toward a sedentary lifestyle, necessitating urgent intervention. Despite the increasing burden of MetS, there is a limited focus on cost-effective and sustainable lifestyle interventions tailored to obese adults in India. Lifestyle adjustments, especially healthier dietary choices and improved activity levels, are regarded as the most beneficial non-medical approaches for managing MetS. Increased consumption of dietary fiber from fiber-rich grains, fresh fruits, and nutrient-dense vegetables is associated with better glycemic control, lower triglyceride levels, and reduced oxidative stress, aiding in the management of the key factors of MetS **(Wei *et al* ., 2018).** Engaging in consistent physical activity is essential to enhance insulin responsiveness, decrease visceral fat, and support overall metabolic health **(Muñoz-Vera *et al.* 2017)**. However, additional studies are needed to evaluate sustained adherence to these interventions and their effectiveness across diverse populations. With the increasing prevalence of MetS and its associated comorbidities, this study explored the impact of lifestyle modifications on its management in obese adults, emphasizing cost-effective and sustainable interventions to enhance metabolic wellness and reduce the long-term threat of NCDs.

2. METHODS

2.1. PARTICIPANT SELECTION

This research was conducted at PSG Hospitals in Coimbatore, Tamil Nadu, after obtaining ethical approval. A total of 100 obese adult men aged 36–55 years were recruited from the outpatient department. To be eligible for the research, individuals were required to have a Body Mass Index (BMI) ≥ 25 kg/m². Individuals with severe medical conditions, including cancer or AIDS, cognitive impairment, or those outside the designated age range were excluded.

2.2. ETHICAL CONSIDERATIONS

This study was approved by the Institutional Human Ethics Committee of the PSG Institute of Medical Sciences and Research (Coimbatore, India) approved this study. Before participation, all participants received detailed information about the study and provided signed consent.

2.3. DATA COLLECTION AND MEASUREMENT

BMI data were collected through structured interviews to gather information on the participants' socioeconomic status, dietary patterns, and lifestyle habits. Standardized procedures were used to measure the body composition, including anthropometric parameters. BMI was calculated as weight (kg) / height (m²), with ≥ 25 indicating obesity grade in Asian adults. MetS was identified according to the modified NCEP ATP III, 2005 guidelines, which define MetS as the occurrence of at least three of five criteria: waistline ≥ 90 cm for men, elevated fasting plasma glucose (≥100 mg/dL), high triglyceride levels (≥150 mg/dL), reduced HDL cholesterol (<40 mg/dL for men), and increased blood pressure (≥130/85 mmHg). Clinical assessments, including biochemical assessments, were conducted before and after the intervention, using standard medical protocols. Individuals exhibiting three or more of these criteria were classified as having MetS.

2.4. LIFESTYLE INTERVENTION PROGRAM

Among 100 obese men, a subsample of 30 patients with MetS received personalized counseling, pamphlets, and PowerPoint presentations on healthy eating, dietary guidance on fiber-rich foods, and physical activity support, encouraging 30 minutes of daily exercise.

2.5. DATA ANALYSIS

The effectiveness of the program in enhancing nutritional knowledge was evaluated using paired t-test, which compared before and after intervention scores. Data analysis was performed using SPSS, with results expressed as mean ± standard deviation.

3. RESULTS

3.1. AGE DISTRIBUTION OF THE SELECTED SUBJECTS

Figure 1 depicts the participants' age demographics: 8% were aged 36–40 years, 17% were 41–45 years, 28% were 46–50 years, and 47% were 51–55 years old. These findings align with those of Kamble et al. (2010), who reported a lower prevalence (4%) among individuals aged < 30 years, with a significant increase to 24.5% among those aged 50 years and above.

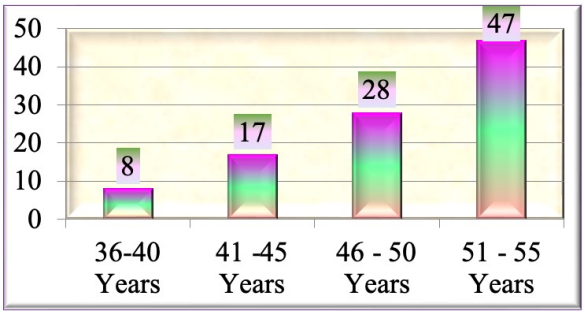

FIGURE 1
AGE DISTRIBUTION OF THE PARTICIPANTS

3.2. PREVALENCE AND RISK FACTORS OF METS

Table I presents information on the high incidence of MetS, recorded at 64% in obese adult men, consistent with previous studies indicating a rising trend of MetS in India. Abdominal obesity (70%), dyslipidemia (65%), hypertension (60%), and fasting glucose level ≥100 mg/dL (55%) were the most frequently observed risk factors, highlighting the clustering of metabolic abnormalities in this population. These results support the findings of Chow ***et al.*** **(2008),** who reported similar prevalence rates in South Indian populations, reinforcing the urgent need for lifestyle interventions to mitigate the progression of MetS. Excessive caloric intake, along with a lack of exercise, is a key contributor to MetS. The study revealed that participants had an excessive intake of energy, carbohydrates, protein, and fat, whereas their fiber and micronutrient consumption was insufficient. These dietary imbalances are linked with obesity, hyperinsulinemia, and dyslipidemia, is consistent to the results of **Motwani *et al.* (2024)**, who identified similar nutritional patterns in obese individuals. Additionally, smoking, alcohol consumption, and low vegetable intake emerged as key lifestyle factors exacerbating MetS risk, consistent with research by **Prasad *et al.* (2012)**, who emphasized the importance of poor dietary habits in metabolic disorders.

TABLE I
PREVALENCE OF METS COMPONENTS AMONG PARTICIPANTS (N=100)

MetS Component	Number of Participants
Abdominal Obesity (WC ≥ 90 cm)	70
Dyslipidemia (Triglycerides ≥ 150 mg/dL)	65
Fasting glucose ≥ 100 mg/dL	55
Hypertension (BP ≥ 130/85 mmHg)	60
HDL Cholesterol ≤ 40 mg/dL	50
MetS Diagnosis (≥3 criteria SMetS)	64

*Modified NCEP III Criteria (2005)

3.3 NUTRIENT INTAKE AND DIETARY PATTERNS

TABLE II
NUTRIENT INTAKE (N=100)

Nutrient	Mean Intake	RDA (2020)	% Excess /Deficit
Energy (kcal)	2598.14± 412.24	2110	+ 488.14
Carbohydrates (g)	423.34± 87.34	290.1	+133.24
Protein (g)	56.23± 32.34	54	+2.23
Fat (g)	54.30± 20.59	25	+29.3
Fiber (g)	20.14± 5.80	42.2	-22.06
Iron (mg)	14.54± 3.56	19	-4.46
Calcium (mg)	543.53± 123.46	1000	-456.47
Vitamin C (mg)	32.75± 12.54	80	-47.25

Table II indicates the impact of targeted lifestyle interventions on key metabolic parameters, showing significant improvements, particularly among the 30 MetS-diagnosed individuals who participated in nutrition education. This study demonstrated that these interventions effectively enhanced metabolic health outcomes. These results align with the observations of **Joshi *et al.* (2014)** reported that "high carbohydrate and calorie intake significantly contributes to obesity and insulin resistance. Similarly, **Motwani *et al.* (2024)** highlighted that "excess protein and fat intake are associated with dyslipidemia," reinforcing concerns regarding metabolic imbalances. These findings underscore the importance of dietary interventions, as suggested by **Thuita and Watetu (2021)**, who emphasized fiber-rich and micronutrient-

balanced diets to mitigate the risks associated with MetS.

3.4. EFFECT OF LIFESTYLE MODIFICATIONS ON METABOLIC PARAMETERS

TABLE III
CHANGES IN METABOLIC PARAMETERS BEFORE AND AFTER THE INTERVENTION (N=30)

Parameter	Before Mean ± SD	After Mean ± SD	% Change
Waist Circumference (cm)	102.4 ± 5.8	98.1 ± 5.3	-4.2%
Fasting Glucose (mg/dL)	108.6 ± 9.2	102.4 ± 8.6	-5.8%
Triglycerides (mg/dL)	185.2 ± 21.5	173.2 ± 19.8	-6.5%
Systolic BP (mmHg)	138 ± 10	130 ± 9	-5.8%
Diastolic BP (mmHg)	90 ± 8	85 ± 7	-5.5%

Table III indicates the significant improvements in key metabolic parameters following targeted lifestyle interventions, particularly among 30 MetS-diagnosed individuals who participated in nutrition education. The study demonstrated that these interventions effectively enhanced metabolic health outcomes. Following the intervention, waist circumference decreased by 4.2%, fasting glucose levels decreased by 5.8%, and triglyceride levels decreased by 6.5%, indicating enhanced metabolic health. Blood pressure also showed notable reduction, with systolic and diastolic levels decreasing by 5.8% and 5.5%, respectively. These findings align with those of clinical trials and lifestyle intervention studies such as **Misra *et al.* (2008),** who reported similar improvements in metabolic markers following dietary and physical activity modifications.

3.5. EFFECTIVENESS OF NUTRITION EDUCATION

Table IV indicates that the nutrition intervention, which included pamphlets and PowerPoint presentations, was effective in promoting positive behavioral changes. Post-intervention data revealed that 40% of the participants adopted healthier food choices, 25% increased physical activity, 50% reduced junk food intake, and 33% improved fiber consumption. These results underscore the importance of structured education programs in influencing dietary and lifestyle behaviors, aligning with the studies by **Shahnazari *et al.* (2021)**, who demonstrated that traditional educational tools significantly enhance nutrition awareness and compliance.

TABLE IV
BEHAVIORAL CHANGES IN PARTICIPANTS AFTER NUTRITION EDUCATION (N=30)

Behavioral Change	Number of Participants (%)
Healthier Food Choices	12 (40%)
Increased Physical Activity	8 (25%)
Reduced Junk Food Consumption	15 (50%)
Increased Fiber Intake	10 (33%)

3.6. FACTORS CONTRIBUTING TO METABOLIC SYNDROME

TABLE V
LIFESTYLE RISK FACTORS IN PARTICIPANTS (N=100)

Risk Factor	Number of Participants
Smoking	18
Alcohol Consumption	22
Low Vegetable Intake (<3 servings/day)	65
Physical Inactivity	55

Table V presents the lifestyle risk factors among the 100 respondents, showing that 18% were smokers, 22% consumed alcohol, 65% had low vegetable intake (fewer than three servings per day), and 55% had a physically inactive lifestyle. The present results align with those of Joshi et al. (2014), who underscored the significant impact of smoking and inadequate vegetable consumption on MetS risk. In this study, the high proportion of participants with low vegetable intake and physical inactivity likely contributed to metabolic imbalances, emphasizing the need for targeted interventions that promote healthier dietary habits and increase physical activity to mitigate the risk of MetS.

3.7. NUTRIITON KNOWLEDGE

Table VI illustrates a significant enhancement in nutritional knowledge among participants, as reflected in the increase in mean scores from 5.64 ± 1.31 before the intervention to 9.34 ± 1.85 following the intervention. The statistically significant p-value (0.000) highlights the effectiveness of educational tools, such as pamphlets and PowerPoint presentations, in enhancing nutrition awareness. These findings align with those of **Shahnazari *et al.* (2013),** who

emphasized the role of traditional educational methods in enhancing dietary knowledge.

TABLE VI
NUTRITION KNOWLEDGE (N=30)

Nutrition Knowledge	Mean ± SD	t-value	p-value
Before	**5.64±1.31**	**-23.45**	**0.000***
After	**9.34±1.85**		

3.8. ADDRESSING THE GROWING BURDEN OF METS IN INDIA

The study findings emphasize the critical need for large-scale community-based interventions to manage MetS in high-risk populations. Given that India has one of the highest global burdens of MetS, integrating nutritional education, dietary modifications, and physical activity promotion into public health policies can help curb its prevalence. Routine screening programs, lifestyle counseling in clinical settings, and digital health initiatives could further enhance awareness and long-term adherence to healthier habits. The results highlight that socioeconomic factors, accessibility to healthy food options, and sedentary urban lifestyles contribute significantly to MetS risk. Public health strategies should focus on affordable healthy food choices, worksite wellness programs, and culturally tailored interventions to encourage sustainable lifestyle modification.

4. CONCLUSION

This study emphasizes the influence of lifestyle modifications on the management of MetS in obese adults. After the intervention, the waist circumference was reduced by 4.2%, fasting glucose by 5.8%, and triglycerides by 6.5%. Additionally, 40% of the participants improved their diet and 25% increased their physical activity. Targeted nutrition education and lifestyle interventions were effective in 64% of the study group diagnosed with MetS. Integrating these strategies into health care policies can enhance long-term disease prevention. Public health initiatives should prioritize a balanced nutrition and an active lifestyle. Future research must explore scalable interventions for sustained impacts.

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