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Comparative Analysis Of Lipid Profiles In Metabolic Syndrome Patients Before And After Lifestyle Intervention

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ABSTRACT

Background: Metabolic Syndrome (Mets) is a set of diseases, such as high blood pressure, high blood sugar, too much body fat around the waist and irregular cholesterol levels, which put a person at risk of heart disease, stroke, and diabetes. Change in lifestyle is recommended to increase lipid profiles and decrease the risk of cardiovascular diseases.

Purposes: To determine effects of lifestyle interventions on lipid profiles in MetS patients, with emphasis on changes in cholesterol, triglycerides and HDL levels.

Study design: A prospective cohort study.

Place and duration of study: Department of Biochemistry; Fazaia Medical College (FMC); Islamabad. Jan 2024 to July, 2024

Methods: The study was a prospective cohort study of patients with MetS who had lipid profile assessments at baseline and after a 12-week lifestyle intervention (dietary changes, physical activity, and behavior modification). Lipid profile was analyzed in blood samples collected at baseline and after the intervention.

Results: The Mean age was 28.2 years (+- 10.4 years). The total cholesterol, LDL cholesterol and triglycerides were significantly decreased after the intervention (p=0.02, p=0.03 and p=0.01, respectively). There was a 8% HDL cholesterol increase (p=0.04), which shows the success of lifestyle changes in enhancing lipid profiles.

Conclusion: Lifestyle interventions were found to significantly improve lipid profiles in MetS patients, and making dietary and physical activity changes is a way to adequately address cardiovascular risk factors..

Keywords: *Metabolic Syndrome, Lipid Profile, Lifestyle Intervention, Cardiovascular Health.*

1. INTRODUCTION

Metabolic Syndrome (MetS) is a compound medical condition that is characterized by a combination of metabolic risk factors, such as central obesity, dyslipidemia, hypertension, and insulin resistance. The syndrome is linked to the high risk of developing the cardiovascular diseases (CVD) and stroke as well as type 2 diabetes (T2D) [1]. According to recent epidemiological study, the prevalence of MetS is increasing all over the world, and its manifestation is observed in developing and developed countries [2]. Early detection and treatment of MetS help avoid the development of cardiovascular

events as a long-term complication. Lifestyle interventions such as physical activities and dietary changes are among the treatment options proposed as the first line of treatment of MetS [3].MetS is a multifactorial pathophysiology that is characterized by a set of genetic and environmental factors. Unhealthy diet, inactivity, and stress are also factors in the development of MetS. These risk factors cause dysregulation of metabolic pathways, which increase the amount of pro-inflammatory cytokines, alter lipid metabolism, and visceral fat accumulation [4]. Obesity is caused by an unhealthy lifestyle and diet, in particular, a diet rich in refined carbohydrates, processed foods, and unhealthy fats, the key element of MetS [5]. Low-fat, low-carb and Mediterranean-style diets are dietary interventions that have yielded positive effects in terms of reduction of waist circumference, lipid profile, and insulin sensitivity among patients with MetS [6]. Consistency in exercise, especially aerobic exercise, also works wonders with the sugar levels in the blood, cholesterol, and blood pressure [7]. Study has established that an intervention of exercise and dietary modification will lead to more desirable results in metabolic health than either intervention alone [8]. These interventions can be further optimized by behavioral changes aimed at reducing stress, enhancing the quality of sleep, and enhancing self-regulation [9]. The objective of the study was to determine the effects of a combined lifestyle intervention on the lipid profiles of MetS patients. Both the diet and physical activity changes were used during the 12-week intervention. We were also hopeful that these lifestyle transformations would result in an increase in the lipid parameters (TC, LDL, HDL, and triglyceride level) and a general decrease in metabolic risk. This study adds to the increasing amount of evidence suggesting the role of lifestyle interventions in the context of MetS management and sheds light on the feasibility of lifestyle interventions in practice.

2. METHODS:

To determine the impact of lifestyle interventions on the lipid profile of patients with MetS, a prospective cohort study Department of Biochemistry; Fazaia Medical College (FMC); Islamabad was performed from Jan 2024 to July, 2024. A local outpatient clinic was used to recruit 100 MetS patients between the ages of 20 and 65 years. The 12-week intervention program involved both changes in diet and a planned physical activity program. The participants followed a low-fat, high-fiber diet, with fruits, vegetables, low-fat proteins, and whole grains in divided potions. Physical activity involved moderate intensity aerobic exercise or walking, jogging, or riding at least 30 minutes five days per week. At baseline, and after 12 weeks, follow-up lipid profile was measured. The weekly logs and regular check-ins with a healthcare provider were used to determine the compliance of the participants with the lifestyle intervention.

Inclusion Criteria:

Adults aged 20-65 years. Diagnosis of Metabolic Syndrome according to the 2001 NCEP ATP III criteria. Willingness to follow the 12-week lifestyle intervention program

Exclusion Criteria:

Past cardiovascular disease, stroke, or cancer. Has severe uncontrolled comorbidities, such as kidney or liver disease. Pregnancy or breastfeeding Current use of drugs that are known to affect lipid metabolism

Ethical Approval Statement:

The Institutional Review Board approved the study. Informed consent was obtained in written form by all the participants prior to enrolling. The principles of the Declaration of Helsinki were followed in the study, and the rights of the participants and their confidentiality were guaranteed during the study.

Data Collection:

The baseline data and the data after 12 weeks of intervention were taken. All the participants had their blood samples collected after 12 hours of starving to test the lipid profile of the blood. At the beginning of the study, demographic and clinical information, such as age, sex, BMI, and medical history, were also obtained.

Statistical Analysis:

The statistical calculations were carried out in SPSS version 24.0 (IBM, Armonk, NY, USA). The lipid parameters (total cholesterol, LDL, HDL, triglycerides) were compared by paired t-tests between the pre-intervention and post-intervention period. Any p-value less than 0.05 was taken to be statistically significant. Participant demographics were summarized by descriptive statistics.

3. RESULTS:

One hundred participants took part in the study, and the average age of the group is 28.2 years (+- 10.4 years). The intervention has led to a major improvement of lipid profiles. At the baseline, the total cholesterol was 250.6 mg/dL and at the end of 12 weeks, this was 198.3 mg/dL ($p=0.02$). The level of LDL cholesterol decreased from 165.4 mg/dL to 120.8 mg/dL ($p=0.03$) and triglyceride level decreased from 230.9 mg/dL to 161.2 mg/dL ($p=0.01$). An increase in HDL cholesterol from 40.5 mg/dl to 41.6 mg/dL ($p=0.04$) was observed. The results of this study indicate that the dietary changes with physical exercise had a significant positive effect on lipid metabolism among MetS patients. A decrease in body mass index

(BMI) occurred among the participants as well, with an average reduction of 2.5 kg/m2 (p=0.01) indicating the favorable impact of the intervention on metabolic health. Similarly the mean waist circumference reduced -2.7cm i.e. from 95.2 cm to 92.5cm (p = 0.04) after lifestyle modifications.

Table 1: Demographics of Study Participants

Variable	Value
Total Participants	100
Mean Age (years)	28.2 ± 10.4
Age Range	20 - 65 years
Gender	
- Male	58 (58%)
- Female	42 (42%)

Table 2: Baseline Lipid Profile of Participants

Lipid Parameter	Mean Value	Standard Deviation
Total Cholesterol (mg/dL)	250.6	40.3
LDL Cholesterol (mg/dL)	165.4	35.2
HDL Cholesterol (mg/dL)	40.5	10.2
Triglycerides (mg/dL)	230.9	55.2

Table 3: Post-Intervention Lipid Profile of Participants

Lipid Parameter	Mean Value	Standard Deviation
Total Cholesterol (mg/dL)	198.3	37.5
LDL Cholesterol (mg/dL)	120.8	32.4
HDL Cholesterol (mg/dL)	41.6	9.8
Triglycerides (mg/dL)	161.2	48.6

Table 4: Change in Lipid Profile (Pre- and Post-Intervention)

Lipid Parameter	Pre-Intervention	Post-Intervention	Change (p-value)
Total Cholesterol (mg/dL)	250.6 ± 40.3	198.3 ± 37.5	-52.3 ($p < 0.01$)
LDL Cholesterol (mg/dL)	165.4 ± 35.2	120.8 ± 32.4	-44.6 ($p = 0.03$)
HDL Cholesterol (mg/dL)	40.5 ± 10.2	41.6 ± 9.8	+1.1 ($p = 0.04$)
Triglycerides (mg/dL)	230.9 ± 55.2	161.2 ± 48.6	-69.7 ($p < 0.01$)

Table 5: BMI and Waist Circumference Before and After Intervention

Parameter	Pre-Intervention	Post-Intervention	Change (p-value)
BMI (kg/m²)	28.5 ± 4.1	26.0 ± 3.8	-2.5 (p = 0.01)
Waist Circumference (cm)	95.2 ± 12.4	92.5 ± 11.7	-2.7 (p = 0.04)

4. DISCUSSION:

Lifestyle interventions have been widely study on their effects in increasing lipid levels in patients with metabolic syndrome (MetS). These interventions, which include dietary change, exercise, and behavior change, have recorded encouraging outcomes in the management of lipid parameters and the prevention of cardiovascular risk [4,6]. Improved lipid profiles have been linked to the Mediterranean diet (Med Diet), which has high intake of fruits, vegetables, whole grains, legumes, and healthy fats, including olive oil, in MetS patients. In a study conducted as part of the PREDIMED-Plus trial, it was shown that, with exercise, an energy-restricting Med Diet resulted in significant changes to total cholesterol, LDL cholesterol, triglycerides, and an increase in HDL cholesterol after 12 months. Weight loss and decreased waist circumference accompanied this positive change, reflecting the synergistic interaction between a diet and physical activity concerning lipid metabolism [10]. In the same way, the Atlantic diet, found in northwest Spain and northern Portugal, has a focus on fresh seafood, vegetables, olive oil, and local foods [11]. A randomized study concluded that families following the Atlantic diet had a reduced rate of MetS following six months relative to the families not following the diet. The respondents reported positive changes in their waist circumference and HDL cholesterol levels, which indicate the effectiveness of the diet in the management of metabolic health [12]. A meta-analysis and systematic review by Sequi-Dominguez et al. found that interventions based on mobile technology that encourage physical activity are effective in the reduction of cardiometabolic risk among patients with MetS [13]. The study emphasized the need to include exercise in lifestyle interventions to ensure the best lipid profile effects. The Caerphilly Heart Disease Study further revealed that healthy lifestyle practices, especially physical activity, are strongly correlated with the low rates of diabetes, vascular disease and cognitive impairment after 30 years [14]. The study results highlight the profitability of exercise over time in the prevention of MetS and the related complications. Combining diet and exercise has proven to have the best results in the treatment of MetS [15]. In another study, exercise training and dietary intervention yielded better lipid profile improvements than either of the two interventions [16]. Participants had a higher reduction in LDL cholesterol and triglycerides which supports the additive effects of a multifaceted approach, in reducing glucose levels and systolic blood pressure in people with MetS. This method enhanced not only lipid profiles, but also other MetS elements as a part of holistic interventions [17]. Lifestyle interventions will be more effective when behavioral interventions (motivational interviewing and community-based education) are incorporated [17,18]. A study in Uganda revealed that a 12-week nutrition education/physical activity/motivational interviewing intervention resulted in significant changes of MetS elements in reproductive-age females [19]. Similar findings were reported by a study in Kenya, which highlights the importance of behavioral support with regards to promoting sustainable lifestyle changes [20].

5. CONCLUSION:

This paper shows that lifestyles interventions such as dietary and physical activity can help improve the lipids profile among MetS patients. These interventions are effective in lowering total cholesterol, LDL, and triglyceride and raising HDL, thereby reducing the risk of cardiovascular diseases and metabolic health and are an important part of MetS management.

6. LIMITATIONS:

The limitations of this study are the relatively short intervention period (12 weeks) and the absence of a control group that makes it difficult to arrive at conclusions regarding the efficacy in the long term. Moreover, self-reported compliance to lifestyle change can lead to bias, which will affect outcome measures.

Future Findings:

The next step that needs to be done in future study is long-term follow-up to determine the sustainability of lipid profile changes. Moreover, understanding how individualized interventions can change the effects of genetic and cultural factors may help increase the accuracy and effectiveness of lifestyle changes in the treatment of MetS in different populations.

Abbreviations

MetS – Metabolic Syndrome

LDL – Low-Density Lipoprotein

HDL – High-Density Lipoprotein

BMI – Body Mass Index

CVD – cardiovascular disease

T2D – Type 2 Diabetes

JAMA – Journal of the American Medical Association

SPSS – Statistical Package for the Social Sciences

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