Journal of Cardiovascular Disease Research

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 08, 2023

ADOLESCENT METABOLIC SYNDROME: PREVALENCE AND RISK FACTORS FOR ITS DIFFERENT COMPONENTS

Dr. K. K. Sorna Tharika[1], Dr. Sumathy[2], Dr. L. Karpagavel[3]

[1]Assistant Professor, Biochemistry Department, Mamata Medical College, Khammam.
[2]Head of the Department, Biochemistry Department, Chettinad Medical College, Kelambakkam.
[3]Professor, Biochemistry Department, Chettinad Medical College,Kelambakkam

Corresponding Author: Dr. K. K. Sorna Tharika

Abstract:
Metabolic syndrome is a cluster of metabolic abnormalities that has been related to an increased risk of cardiovascular disease and type 2 diabetes. Most people who have metabolic syndrome also suffer from additional metabolic disorders. These disorders include hypertension, abnormal lipid profiles, increased blood sugar, and insulin resistance. The goal of this study was to analyze the relationships between glucose, insulin, HOMA-IR (an estimate of insulin resistance), and lipids in people who had metabolic syndrome. Methods and components: All people included in the study agreed to take part. The "control group" consisted of 100 individuals of the same age and gender who were otherwise healthy. One hundred patients with metabolic syndrome were included in the second cohort. Normal-glycemic controls of the same age and sex were used as the non-metabolic syndrome group. Individuals in each group were classified as healthy if their BMI fell between 18.5-24.9 kg/m2, overweight if it was 25.2-29.9 kg/m2, and obese if it was 30 kg/m2. There was a statistically significant difference between the two groups in terms of fasting blood glucose (FBS), hemoglobin A1c (Hba1c), and insulin mean values. The average total cholesterol (TC) and triacylglycerols (TAGs) levels of patients with metabolic syndrome and healthy control subjects. Significant differences in serum weight measures across the groups were found. Mean TAGs levels in patients with metabolic syndrome were around 33 % higher than normal, which is still within the normal range. The molecular insights gained from such studies are highly desirable for helping doctors keep hyperglycemia under control and halt the development of associated disorders.
Keywords: High Blood Sugar; Total Cholesterol; American Heart Association; Insulin hormone; Obese.

INTRODUCTION:

According to the estimation provided by the American Heart Association, it is projected that about three million individuals in the United States, specifically children and adolescents aged 12 to 19, are affected by metabolic syndrome [1]. The prevalence of this phenomenon increases to 44% among individuals categorized as overweight or obese within the pediatric population. Research conducted revealed that a significant proportion of the Indian population, specifically 19.52 percent of individuals surveyed, experienced the presence of metabolic syndrome. According to a recent study [2], the prevalence of metabolic syndrome was shown to be 35% higher among women in India compared to men.

Metabolic syndrome is a cluster of metabolic problems that heighten an individual's susceptibility to cardiovascular disease and type 2 diabetes. Furthermore, individuals with metabolic syndrome commonly experience a range of other metabolic complications, including but not limited to elevated blood sugar levels, insulin resistance, atypical lipid profiles, and hypertension [1-5]. Glucose and insulin have a synergistic relationship within the physiological framework of the human body's metabolic pathways. Glucose serves as the predominant source of energy for the human body, whereas insulin, a hormone, plays a crucial role in regulating glucose metabolism by facilitating the uptake of glucose by cells [4,5]. Patients diagnosed with metabolic syndrome often experience insulin resistance [6,7], a physiological state defined by reduced responsiveness of the body to insulin signaling, leading to elevated blood glucose levels. The Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) is a widely utilized approach that quantifies insulin resistance by evaluating fasting glucose and insulin concentrations. Elevated HOMA-IR levels have been found to be correlated with the presence of insulin resistance, as well as an augmented susceptibility to the development of type 2 diabetes and cardiovascular disease. Dyslipidemia is a medical condition

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 08, 2023

that is distinguished by increased concentrations of triglycerides and low-density lipoprotein cholesterol, as well as reduced levels of high-density lipoprotein cholesterol [8,9]. Dyslipidemia often coexists with insulin resistance and glucose intolerance, which are two additional characteristics of metabolic syndrome. In summary, there exists a significant interconnection between glucose, insulin, HOMA-IR, and lipids in individuals diagnosed with metabolic syndrome [8-10]. Metabolic syndrome is characterized by the presence of insulin resistance and is correlated with elevated blood glucose levels, abnormal lipid levels, and an augmented susceptibility to cardiovascular disease and type 2 diabetes [7-9]. The objective of this study was to investigate the associations among lipids, insulin, glucose, and HOMA-IR in individuals diagnosed with metabolic syndrome.

MATERIALS & METHODS:

Seventy-five patients with metabolic syndrome and seventy-five healthy people made up the 150 participants in the current study. Patients at the Chettinad Medical College and Research Centre were the subjects of this research. Before beginning the investigation, researchers waited for approval from the proper authorities. All subjects provided informed consent before the study began. Type 1 diabetics and those with T2DM who were diagnosed within the past five years were also excluded, as were those with pathological symptoms. Concomitant conditions were absent in the non-diabetic, non-multivitamin taking controls.

A hospital physician assessed all patients in both groups according to standard protocols and study inclusion/exclusion criteria. The control group consisted of seventy-five individuals without metabolic syndrome but of similar age and gender. In the second cohort, 75 patients with metabolic syndrome were added. Metabolic syndrome was identified using the ATP-III criteria. The control group consisted of volunteers of a comparable age and gender who had normal blood sugar levels to begin with. Standard medical procedures were used in each patient's examination. Metabolic syndrome was identified using the ATP-III criteria. By dividing each participant's kilogram weight by the square of their meter height, we were able to calculate their body mass index (BMI). Each participant was placed in one of three categories based on their body mass index. Each cohort's participants were further divided into three categories based on their BMI using the World Health Organization's diagnostic criteria for obesity in Asian populations: normal weight (18.5-24.9 kg/m2), overweight (25-29.9 kg/m2), and obese (30 kg/m2). In a sterile environment, 5ml of fasting venous blood was taken from each subject in both groups into flat receptacles using a disposable syringe and cannula. The samples were aliquoted and stored at 20 ° C after being centrifuged at 3000 rpm for 20 minutes to separate the serum from the blood.

The DPEC - GOD/POD method, created by Avantor Laboratories, was used to analyze the glucose levels in the plasma. The reagents were synthesized by strictly adhering to the manual's instructions. The ClinRep full kit was utilized for HbA1C testing on the BioRad Diamant and Variant. Common values fall between 4.5–6.1%. Using an LDN IRMA reagent, the serum insulin concentration was determined. All the suggestions made by the manufacturer were implemented. With an inter- and intra-assay CV of 4.3% and 3.4%, respectively, sensitivity was calculated to be 0.5 IU/mL. Methods for calculating HOMA-IR were based on those developed by Muniyappa et al. (2008). For the lipid profile, serum TC was evaluated using the CHOD/POD method. TAG concentrations in the serum were measured using glycerol phosphate oxidase and peroxidase (Liquid stable). We determined the concentrations of the analytes in question using a kit purchased from Avantor Performance Materials India Limited in Dehradun, Uttarakhand, India. All of the suggestions made by the manufacturer were implemented.

STATISTICAL ANALYSIS:

The means of the variables of the two groups were compared using an unpaired "t" test. Furthermore, calculations were performed to determine the percentages. The examination of the link between the two variables was conducted through the utilization of scatter plots. Furthermore, calculations were performed to determine the percentages. The researchers achieved consensus on adopting a significance level of 0.05.

RESULTS:

The results are presented, which include a comparison of the two groups' fasting blood glucose (FBS), postprandial blood glucose (PP), glycated hemoglobin (HbA1c), insulin, and HOMA-IR readings. When the two groups were compared, there was a significant difference in fasting blood sugar (t=16.16; df=148; P 0.05), hemoglobin A1c (t=19.32; df=148; P 0.05), and insulin mean levels (t=12.34; df=148; P 0.05). Patients with metabolic syndrome had

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 08, 2023

a mean post-prandial blood glucose level of 153 (SD = 48) compared to 163.5 (SD = 23) in the healthy controls. We found that the HOMA-IR level was 26 % higher in people with metabolic syndrome compared to healthy controls. Because we used individuals of the same age and gender in both groups, the percentages improved. We calculated the HOMA-IR and measured the intensity of IR in both sets of subjects.

When we compared the mean levels of TC and triacylglycerols (TAGs) between patients with metabolic syndrome and healthy controls, there was a large discrepancy between the two groups' serum weight measurements. Patients with metabolic syndrome had mean TAGs levels that were 33% higher than average, however, this was still much lower than the norm.

DISCUSSION:

It is conceivable that metabolic syndrome triggers a chain reaction that leads to diabetes complications. Metabolic syndrome is characterized by hyperglycemia and a low body mass index, suggesting that this condition may initiate the chain reaction. This is because individuals with metabolic syndrome are underweight. Lack of body fat and hyperglycemia both contribute to this condition.

Patients with metabolic syndrome had higher levels of FBS, Hba1c, and insulin than the healthy control group. Comparing the ages of the individuals in the two groups revealed no statistically significant differences in this regard. The conclusion was determined by the study's findings. Those diagnosed with metabolic syndrome who participated in the study exhibited an increase in mass without any fat. Participants strong enough to serve as controls did not manifest this trend in body composition [10-12]. This study suggests that the higher blood sugar levels in the metabolic syndrome group may be a consequence of aging. Our findings also highlight concerns associated with aging in patients with metabolic syndrome. Current research [10,11] indicates that metabolic syndrome is one of the diseases associated with the aging process. Researchers [1-9] discovered that individuals over 40 are more likely to develop metabolic syndrome. This conclusion was reached after two distinct investigations. Surprisingly, the researchers discovered no correlation between the participants' ages and their blood sugar levels in the control group. On the other hand, we did observe a difference in age between those with metabolic syndrome and those without it, but the difference was not statistically significant. Those with a high metabolic syndrome predisposition are more likely to develop the condition than those with a low predisposition, according to this finding. Those who are genetically predisposed to metabolic syndrome are more likely to develop the condition than those who are not. Those who are genetically predisposed to developing metabolic syndrome are more likely to do so. Adults older than 65 have the highest prevalence of diabetes; however, geriatric adults are frequently excluded from many studies, including diabetes research [13,14].

The observation of an inverse relationship between age and HbA1c in both metabolic syndrome and control groups must be thoroughly investigated. Both volunteer organizations discovered this independently. A plausible explanation is that oxidative stress increases with age and that the increase in HbA1c is a compensatory response to both aging and the production of free radicals. Another plausible hypothesis is that oxidative stress increases with age and that the increase in HbA1c is the result of both aging and the production of free radicals. There is also the theory that oxidative stress increases with age and that both aging and free radical production contribute to the rise in HbA1c. This is yet another logical justification. Numerous studies [11-14] have demonstrated that individuals with metabolic syndrome are more likely than healthy controls or individuals of the same age to have elevated levels of oxidative stress. Although no attempt was made to measure levels of free radicals, the research clearly demonstrates that oxidative stress is elevated in both patients with metabolic syndrome and geriatric controls [7-11]. Individuals with metabolic syndrome exhibited statistically significant changes in postprandial blood glucose levels and serum weight compared to healthy controls. Comparing individuals with metabolic syndrome to healthy controls revealed this. Produced by the pineal gland and other organs, weight is a hormone that regulates endocrine and biological processes. In addition, maintaining a balance between normal normoglycemia and elevated hyperglycemia requires the interaction between BMI and insulin. This condition is necessary for the typical functioning of the organism. According to global investigations [11,12], individuals with a disruption in this crosstalk develop hyperglycemia. Obesity is associated with hyperglycemia and the risk of developing metabolic syndrome in predisposed individuals, according to genome-wide investigations [15,16]. Previous studies [9,10] have shown that adiposity increases insulin sensitivity. These findings [17-19] are bolstered by the discovery that an

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 08, 2023

alteration in insulin homeostasis may increase insulin resistance and hyperglycemia. As a result, it has been observed that people with elevated blood glucose levels were less likely to be obese. This is true because glucose prevents weight accumulation. This study confirms previous findings that people with metabolic syndrome have abnormally high blood sugar levels (hyperglycemia). Underweight individuals were more likely to have metabolic syndrome, which leads to postprandial hyperglycemia. Therefore, we can conclude that postprandial hyperglycemia is the result of a reduction in body mass. Contrary to the findings of a previous study, injecting male Wistar rats with weight had no effect on their blood glucose levels. This is true even though the rodents were not weighed.

CONCLUSION:

Research of this nature is encouraged since it is expected to result in molecular discoveries that will aid physicians in controlling hyperglycemia and slowing the development of related illnesses. Researchers will get new molecular insights from these investigations, which could one day aid in the treatment of hyperglycemia. Insufficient compensatory mechanisms to deal with pathophysiological anomalies may characterize people with metabolic syndrome, the results suggest. This finding was established by the current study notwithstanding the fact that there had been no prior extensive investigation of the topic.

Conflict of interest:

The authors of this work do not have any competing interests that could be seen as a conflict of interest.

REFERENCES:

1. Rodríguez-Correa E, González-Pérez I, Clavel-Pérez PI, Contreras-Vargas Y, Carvajal K. Biochemical and nutritional overview of diet-induced metabolic syndrome models in rats: what is the best choice?. Nutrition & diabetes. 2020 Jul 2;10(1):24.
2. James M, Varghese TP, Sharma R, Chand S. Association between metabolic syndrome and diabetes mellitus according to International Diabetic Federation and National Cholesterol Education Program Adult Treatment Panel III criteria: a Cross-sectional study. Journal of Diabetes & Metabolic Disorders. 2020 Jun;19:437-43.
3. Bekel GE, Thupayagale-Tshweneagae G. Prevalence and associated factors of metabolic syndrome and its individual components among adolescents. Int J Public Health Sci. 2020 Mar;9(1):46-56.
4. Hadi A, Arab A, Khalesi S, Rafie N, Kafeshani M, Kazemi M. Effects of probiotic supplementation on anthropometric and metabolic characteristics in adults with metabolic syndrome: A systematic review and meta-analysis of randomized clinical trials. Clinical nutrition. 2021 Jul 1;40(7):4662-73.
5. Rajpal A, Ismail□Beigi F. Intermittent fasting and 'metabolic switch': Effects on metabolic syndrome, prediabetes and type 2 diabetes. Diabetes, Obesity and Metabolism. 2020 Sep;22(9):1496-510.
6. Doddigarla Z, Parwez I, Abidi S, Ahmad J. Effect of Melatonin and Chromium Picolinate Administration to High Carbohydrate Diet-Fed Male Wistar Rats. J Mol Genet Med. 2017;11(245):1747-0862.
7. Ali N, Miah R, Hasan M, Barman Z, Mou AD, Hafsa JM, Trisha AD, Hasan A, Islam F. Association between serum uric acid and metabolic syndrome: a cross-sectional study in Bangladeshi adults. Scientific reports. 2020 May 12;10(1):7841.
8. Yusufi FN, Doddigarla Z, Ahmed A, Ahmad J. Validation of Swedish and Chinese 5-year heart disease prediction models on Indian type 2 diabetes mellitus patients. Int. J. Agricult. Stat. Sci. Vol. 2021;17(2):461-70.
9. Li YW, Kao TW, Chang PK, Chen WL, Wu LW. Atherogenic index of plasma as predictors for metabolic syndrome, hypertension and diabetes mellitus in Taiwan citizens: a 9-year longitudinal study. Scientific reports. 2021 May 10;11(1):9900.
10. Haque T, Rahman S, Islam S, Molla NH, Ali N. Assessment of the relationship between serum uric acid and glucose levels in healthy, prediabetic and diabetic individuals. Diabetology & metabolic syndrome. 2019 Dec;11(1):1-8.
11. Wang HH, Lee DK, Liu M, Portincasa P, Wang DQ. Novel insights into the pathogenesis and management of the metabolic syndrome. Pediatric gastroenterology, hepatology & nutrition. 2020 May;23(3):189.
12. Rahimlou M, Yari Z, Rayyani E, Keshavarz SA, Hosseini S, Morshedzadeh N, Hekmatdoost A. Effects of ginger supplementation on anthropometric, glycemic and metabolic parameters in subjects with metabolic syndrome: A randomized, double-blind, placebo-controlled study. Journal of diabetes & metabolic disorders. 2019 Jun 1;18:119-25.

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 08, 2023

13. Wilkinson MJ, Manoogian EN, Zadourian A, Lo H, Fakhouri S, Shoghi A, Wang X, Fleischer JG, Navlakha S, Panda S, Taub PR. Ten-hour time-restricted eating reduces weight, blood pressure, and atherogenic lipids in patients with metabolic syndrome. Cell metabolism. 2020 Jan 7;31(1):92-104.
14. Katsimardou A, Imprialos K, Stavropoulos K, Sachinidis A, Doumas M, Athyros V. Hypertension in metabolic syndrome: novel insights. Current Hypertension Reviews. 2020 Apr 1;16(1):12-8.
15. DeBoer MD. Assessing and managing the metabolic syndrome in children and adolescents. Nutrients. 2019 Aug 2;11(8):1788.
16. Osadnik K, Osadnik T, Lonnie M, Lejawa M, Reguła R, Fronczek M, Gawlita M, Wądołowska L, Gąsior M, Pawlas N. Metabolically healthy obese and metabolic syndrome of the lean: The importance of diet quality. Analysis of MAGNETIC cohort. Nutrition journal. 2020 Dec;19(1):1-3.
17. Ha K, Song Y. Associations of meal timing and frequency with obesity and metabolic syndrome among Korean adults. Nutrients. 2019 Oct 13;11(10):2437.
18. Lasker S, Rahman MM, Parvez F, Zamila M, Miah P, Nahar K, Kabir F, Sharmin SB, Subhan N, Ahsan GU, Alam MA. High-fat diet-induced metabolic syndrome and oxidative stress in obese rats are ameliorated by yogurt supplementation. Scientific reports. 2019 Dec 27;9(1):20026.
19. Maifeld A, Bartolomaeus H, Löber U, Avery EG, Steckhan N, Markó L, Wilck N, Hamad I, Šušnjar U, Mähler A, Hohmann C. Fasting alters the gut microbiome reducing blood pressure and body weight in metabolic syndrome patients. Nature communications. 2021 Mar 30;12(1):1970.