ORIGINAL ARTICLE

PREVALENCE OF VARIOUS COMPONENTS OF METABOLIC SYNDROME IN OUR YOUNGER POPULATION

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Background: Metabolic Syndrome prevalence all over the world is increasing. Assessment at an early age regarding the presence of these is imperative to early prevention and treatment. This study was conducted to evaluate prevalence of the various components of metabolic syndrome in our adolescent population. **Methods:** A total of 193 young adolescents between ages 17 to 25 years were taken, 106 males and 87 females. Record of each subject's personal, socioeconomic, educational, dietary and family histories was taken. Anthropometric and laboratory investigations done were: waist circumference, hip circumference, height, weight, waist hip ratio, body mass index, and blood pressure. Laboratory investigations performed after an overnight fasting of 12 hours were: Plasma glucose levels. Lipid profile including total cholesterol, HDL-cholesterol, LDL-cholesterol, and triglycerides, and Uric acid levels. Data on all variables required to define the metabolic syndrome according to National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) criteria was recorded. **Results:** Waist hip ratio was increased in 23.8%. Obesity was seen in 34.7%, 29% were overweight, and 5.7% were frankly obese. Blood pressure measurements showed upper normal ranges; in 23.8% subjects high systolic and in 15% subjects high diastolic values were observed. Fasting plasma glucose was high in 4.7%. Fasting serum lipid profile: cholesterol, HDL-cholesterol, LDL-cholesterol and triglycerides: 20.2% fasting serum cholesterol of more than 191 mg/dl, HDL-cholesterol being less than 40 mg/dl in 87.6%. 23.3% had LDL-cholesterol more than 200 mg/dl. Fasting serum triglycerides more than 185 mg/dl seen in 12.5%. Serum uric acid raised in 3.6%. WHR, BMI, Fasting plasma glucose, HDL-c and TG were sensitive indicators of metabolic syndrome. Serum HDL-cholesterol was the most prevalent abnormality followed by obesity. **Conclusion:** Metabolic syndrome is much prevalent in Pakistani adolescents and can be diagnosed using simple and economical investigations.

Keywords: Metabolic syndrome, Dysmetabolic syndrome, Obesity, Adolescent,

INTRODUCTION

Syndrome X/Dysmetabolic Syndrome or Metabolic Syndrome is a non-communicable, non-infectious disease whose prevalence all over the world is increasing. Having tremendous repercussions in terms of cardiovascular and end organ complications, it is on the increase all over the world with Pakistan not being an exception.[1–2] Various definitions tend to explain this amalgam of abnormalities, World Health Organization and National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) to name a few. Metabolic syndrome is defined in patients having three or more of the following:

- Central obesity as measured by the waist circumference (males greater than 40 inches; females greater than 35 inches)
- Fasting triglycerides greater than or equal to 150 mg/dl (1.69 mmol/l)
- HDL-cholesterol [males: less than 40 mg/dl (1.04 mmol/l), females: less than 50 mg/dl (1.29 mmol/l)]
- Blood pressure greater than or equal to 130/85 mm Hg
- Fasting glucose greater than or equal to 110 mg/dl (6.1 mmol/l)[3]

With categorisation based on age grouping, it is seen that incidence in the population increases with an increase in age starting from 3–4% in the younger group going up till 25% in the elderly. Taking into consideration gender specification, this disease is rifer in females than males.[1,4] Females show greater incidence of abnormalities in most of the criteria used in the diagnosis of metabolic syndrome, especially obesity, hypertension and dyslipidemia. Also, associated conditions in females like the polycystic ovarian syndrome predispose them to a greater occurrence of insulin resistance and its accompanying abnormalities.

Obesity, emerging more as an epidemic is rampant in the paediatric population. Eating habits of consuming more 'refined and junk food' induces weight gain at an early age. This coupled with a tendency towards a sedentary lifestyle, without exercise gives way to overweight adults. A number of otherwise healthy yet obese young adults, both males and females have one or more than one components of the syndrome.[5] An increase in body weight of nearly 1 Kg has been seen to increase the risk of metabolic syndrome as opposed to a decrease in 5–10% body weight improving symptoms.[6] Various studies suggest that visceral/android obesity is of more importance than somatic obesity; it is the deposition of excess fat in the abdominal area and abdominal organs. Various methods have been proposed and tested to measure it; the waist circumference (WC) which describes obesity in males being present with a

waist circumference of greater than 40 inches or 102 Cm and in females with a waist circumference greater than 35 inches or 88 Cm. Normal waist-hip ratio (WHR) is less than 1.0 in men and 0.8 in women. Cut-off value for BMI in males with WC >120 Cm and females with WC >88 Cm was 30.[7]

Insulin resistance, as was previously thought, does not essentially come with increasing age. Data suggests increase in circulating insulin levels and associated risk factors such as high blood pressure, altered lipid levels, inflammatory markers and endothelial dysfunction seen as prematurely as early teens.[8] With obesity becoming more rampant in a young age group, incidence of type 2 diabetes mellitus also is catching up. As more and more adolescents are putting on unnecessary pounds, resistance to insulin is also increasing.[9] Insulin resistance is the underlying pathophysiologic defect of type 2 diabetes and its consequent complications. Hence, improving insulin sensitivity would be important as an initial step in improving development of overt symptoms.[10]

Insulin has a major role to play in determining not only glucose metabolism but also influences lipid metabolism of the body. In addition to causing disturbed plasma glucose levels, it also targets the metabolism of lipids causing an increase in the plasma levels of triglycerides, chylomicrons, and free fatty acids (FFA). Studies have indicated that obese individuals of all ages, from childhood to adolescence[11], have high levels of LDL cholesterol, TG and low levels of HDL cholesterol[12]. Easy and abundant availability of these varieties of 'bad cholesterol' in a backdrop of adiposity provides the required cytokines necessary for plaque deposition. Adiposity is correlated with altered production of adipocytokines and inflammatory mediators which are the source of angiopathy and vascular damage. Atherosclerosis results, which in diabetics is more marked in the microvasculature —it affects the coronaries, cerebral vessels and the peripheral vessels. It is the greatest cause for concern in diabetics as this eventually ends up with angina, myocardial infarction, stroke and myriad of end organ diseases.

The link between hypertension and insulin resistance is a hot topic of debate among medical specialists. Numerous theories suggest endothelial dysfunction to be the link between insulin resistance and development of hypertension. Studies indicate vascular sensitivity to insulin showing endothelium to be directly responsive to it by vasodilatation which is mediated by release of nitric oxide from endothelial cells. Both obese non-diabetic and diabetic individuals have been shown to have impaired endothelial function and impaired response to haemodynamic actions of insulin.[13,14] This impairment of endothelium predisposes to macro- and micro-vascular complications leading to cardiovascular thrombotic disease and its inherent defects like enhanced leucocytic adhesion, thrombosis and smooth muscle cell proliferation in the arterial wall. Other schools of thought blame yet different events in the relationship between high blood pressure and metabolic syndrome. Increased activity of the sympathetic nervous system, increased angiotensin II levels, hyperuricemia coupled with salt sensitivity contributes to increased likelihood of these individuals developing essential hypertension. Overall statistical studies indicate hypertension and type 2 diabetes mellitus have a reciprocal relationship. Individuals with hypertension are more likely to develop type 2 diabetes and type 2 diabetics are twice at risk of developing the former. Additional data indicate 75% increase in cardiovascular disease complications in diabetics due to hypertension which means that such patients require intense treatment and monitoring of both their glucose and blood pressure levels.[15]

MATERIAL AND METHODS

This descriptive, cross-sectional study included 193 young adults between 17 and 25 years of age, belonging to middle and upper socioeconomic status. There were 106 males and 87 females. Diagnosed cases of maturity onset diabetes of the young, secondary hypertension, type 1 diabetes mellitus and pregnant women were excluded. Non-probability, convenient sampling technique was adopted.

All subjects were verbally explained the physical measurements and sampling techniques of the study and they completed and signed a consent performa. Each subject was asked about personal, socioeconomic, educational, dietary and family histories. Waist circumference (WC), hip circumference (HC), height, weight, waist hip ratio (WHR), body mass index (BMI) and blood pressure were measured. Laboratory investigations performed on an automatic analyser after an overnight fasting of 12 hours included Plasma glucose, Total Cholesterol (TC), HDL-cholesterol, LDL-cholesterol, and Triglycerides (TG). Uric acid levels were done by enzymatic colorimetric method. Metabolic syndrome was defined according to NCEP ATP III criteria. All data was arranged and analysed using SPSS-15.

RESULTS

Anthropometric measurements regarding waist hip ratio showed more than normal range in about 23.8% subjects. Obesity (based on measurements of WHR, HC, height and weight) showed a trend towards an increasing incidence with values of BMI in both males and females being about 34.7%. Out of these, 29% were overweight, and 5.7% were frankly obese. Blood pressure measurements also showed values towards upper normal range; 23.8% of the population had higher normal values of systolic blood pressure, and 15% had higher normal range of diastolic pressure.

Fasting plasma glucose was seen to be towards the higher normal range in 4.7% of the test population. Out of the total, 20.2% subjects had fasting serum cholesterol more than 191 mg/dl, 87.6% had serum HDL-cholesterol less than 40 mg/dl, and 23.3% had LDL-cholesterol more than 200 mg/dl. Fasting serum triglycerides indicate abnormal values of more than 185 mg/dl in about 12.5%. Serum uric acid was also seen to be raised in 3.6% of the total which fell in the range of 6–6.7 mg/dl.

Table-1: Anthropometric measurements and laboratory investigations according to gender

Parameter	Male (n=106) Mean±SD	Female (n=87) Mean±SD
Waist Circumference (Cm)	73.2453±8.5	68.45±8.3
Hip Circumference (Cm)	88.9528±7.1	94.2414±8.4
Waist Hip Ratio	0.82123±0.08*	0.71580±0.05*
Weight (Kg)	63.1792±11.4	55.0920±10.7
Height (Cm)	169.8113±6.7	160.6207±7.3
BMI (Kg/m^2)	23.4762±5.6*	22.4655±5.5*
Systolic BP (mmHg)	118.54±11.2	106.32±12.9
Diastolic BP (mmHg)	80.75±6.6	73.68±8.8
Fasting Plasma Glucose (mg/dl)	84.4245±10.1	81.2759±9.9
Total Cholesterol (mg/dl)	170.1226±42.2	160.65±32.5
HDL-Cholesterol (mg/dl)	37.0745±3.8	37.1138±2.9
LDL-Cholesterol (mg/dl)	182.8566±47.9	171.5368±34.3
Triglycerides (mg/dl)	120.1132±55.6	124.3149±52.7
Serum Uric Acid (mg/dl)	4.3981±0.61	4.1402±0.83

*$p<0.05$

DISCUSSION

This study on Pakistani adolescents demonstrates the presence of the Metabolic Syndrome. Findings of this study are in conformity with literature published elsewhere worldwide where this syndrome is as much on the rise but in the context of an advanced age group. Limited studies have described the increase in the syndrome in the age group that has been included and a lot are coming up, as apprehension of the presence of this condition is increasing.[16,17] Metabolic syndrome has been defined in various studies using diverse classifications.

A variety of studies indicate diverse components to be most frequent in occurrence. This study had fasting HDL-c as the most common occurrence (87.6% of the subjects) followed by obesity in 34.7%. Increase in lipid levels has been known to be exacerbated by insulin resistance in diabetic patients which is a strong predictor of atherogenic coronary artery disease. Moreover, obesity, as outlined by WHR and BMI, has been found to be highly predictive of the eventual development of metabolic syndrome.[18,20] The findings in present study are supportive of the fact that, indeed, in these youngsters the stage is being set for the ultimate development of the syndrome with all of its inherent complications. Anthropometry reveals WHR also to be substantially raised, 23.8%, males and females inclusive, reflecting the trend of obesity being prevalent at this very young age group. These results are much consistent with medical research in other areas of the world which also relate increasing trends towards being overweight at a very early age.

Group statistics (Table-1) relate WHR and BMI as being the most sensitive indicators of insulin resistance syndrome which is supported by other studies as well, where, a combination of these has been proved to be a better predictor than either alone.[21] Moreover, these two variables are important risk factors for the syndrome as being obese is directly related to being insulin resistant[22] and poses a high risk of having a deranged lipid profile in adults.

One of the most unexpected finding is the extremely deranged values of serum HDL-c in such a young age group. All fractions of serum lipids are also raised. Furthermore, HDL-c and TG has been shown to be one of the most sensitive biochemical indicators of metabolic syndrome in this study. Such a disturbed lipid profile in due course gives rise to 'atherogenic dyslipidemia'. This scenario leads to the slow and steady development of complications, like coronary artery disease, stroke and end stage renal disease.[23–26]

In addition, 4.7% of the individuals also showed high normal range of fasting plasma glucose and a small fraction, 3.6% showed hyperuricemia. There are studies implicating hyperuricemia to hypertension[27], but this study does not reveal any significant correlation between the two. Maybe, a greater number of subjects might reveal a better link or the age of onset may vary from the one used here. However, there is raised frequency of high normal ranges of systolic blood pressure (23.8%) as well as raised high normal values of diastolic blood pressure (15%). Data also shows both these values of hypertension to be highly significant ($p<0.5$). Hence the assumption can be made that our younger population is at risk of developing the metabolic syndrome.

What can be done at this point in time with regard to prevention is critical. Studies indicate that there is marked improvement in all parameters of metabolic syndrome with lifestyle changes; so much so that some writers insist that drugs alone are not enough unless lifestyle changes are implemented.[28,29] These changes include better eating habits, implementing physical activity and weight loss where required.

CONCLUSION

Metabolic syndrome is as much prevalent in the Pakistani population as anywhere else in the world. Keeping in mind that Pakistan has limited health resources, diagnosis of the syndrome can be carried out by simple and cost effective tests as done in this study.

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