Original Research Article

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Study of prevalence of metabolic syndrome in obese children in Konaseema region of India

R. Pratyusha, K. Narayan Rao*

Department of Pediatrics, Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, Andhra Pradesh, India

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*Correspondence:

Dr. K. Narayan Rao,

E-mail: drnrkatada@gmail.com

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ABSTRACT

Background: The rising prevalence of overweight and obesity is associated with development of growing number of early complications in children and adolescents among that type 2 diabetes mellitus and metabolic syndrome (MS) is common. Present study has been designed to identify the prevalence of MS in children with overweight risk, overweight or obesity and to compare anthropometric and biochemical parameters in patients with metabolic syndrome and without MS.

Methods: This is a cross sectional descriptive study conducted in the department of paediatrics where 120 patients with obesity were enrolled for this study and various metabolic parameters were compared.

Results: In our study the prevalence of metabolic syndrome was 30% among obese and overweight children. Fasting insulin $(18.65\pm13.64 \text{ mg/dl} \text{ versus } 16.48\pm10.32 \text{ mg/dl})$ was significantly higher in patients with MS than without MS (p is less than 0.05). Homeostatic model assessment of insulin resistance (HOMA-IR) was 5.84 ± 1.43 in MS group and 4.54 ± 1.34 in without MS group. The p value was 0.00. The glycocylated haemoglobin was significantly higher in MS group than without MS group $(5.84\pm0.78 \text{ versus } 4.54\pm0.34)$.

Conclusions: From our study we can conclude that metabolic syndrome is a common problem in children with overweight and obesity in our region. Insulin resistance and metabolic abnormality were more common in children with MS

Keywords: Metabolic syndrome, Insulin resistance, Children

INTRODUCTION

Overweight and obesity are serious public health challenges of present century. It is a global problem but majority of overweight or obese children live in developing countries. The number of overweight or obese infants and young children has increased from 32 million globally in 1990 to 41 million in 2016. These children are likely to remain obese in adult age and prone to develop noncommunicable diseases like diabetes and cardiovascular diseases at a younger age. The rising prevalence of overweight and obesity is associated with development of growing number of early complications in children and adolescents among that type 2 diabetes

mellitus and metabolic syndrome is common. 4,5 Metabolic syndrome (MS) is a complex disorder, studies has suggested it to be a complex interaction between insulin resistance, obesity and inflammation play an important role in the development of it. 6 It is accumulation of several disorder which together increases the risk for development of atherosclerotic cardiovascular disease. It is defined as condition associated with impaired glucose tolerance test, dyslipidemia, hypertension and obesity. 7 This definition is not applicable for adult and there is no uniformly acceptable definition for MS in children. 8 This ambiguity in definition makes difficult to study prevalence of metabolic syndrome in children and adolescent. Simunovic et al has concluded in his study that his studies

shows high prevalence of MS in the obese child and adolescent population, thus indicating the possibility of early complications in adulthood. Chen et al has concluded that prevalence of MS in different countries has been reported to be 3-4%. In 2007 International diabetes federation has issued a unified definition of metabolic syndrome in children and adult. With this comparison of different study has become easy. Various studies are available regarding prevalence of metabolic syndrome in children but without uniformity. There is no study available in our region to evaluate the prevalence of metabolic syndrome in our population. 10,11

Present study has been designed to identify the prevalence of metabolic syndrome in children with overweight risk, overweight or obesity and to compare anthropometric and biochemical parameters in patients with MS and without MS.

METHODS

This is a cross sectional descriptive study conducted in the department of paediatrics Konaseema institute of medical sciences, Amalapuram India from January 2018 to June 2020.

Ethics

Approval from institutional ethics committee was taken before start of study. A written informed consent was obtained from all patients before enrolling them for study.

Selection of patients

Patients attending outpatient department of paediatric with complain of overweight and obesity were enrolled for this study as per exclusion and inclusion criteria.

Inclusion criteria

Participants in the age group 5 to 17 years of both the sexes and obesity >2SD (equivalent to body mass index i.e. BMI 30 kg/m2 at 19 years) were included in the study. ¹²

Exclusion criteria

Patients suffering from diabetes mellitus, or pre-existing endocrine disorder and patients taking corticosteroid or any other medication were excluded from the study.

Method

Patients who satisfy the selection criteria were enrolled for this study after taking consent from parents. During this study period 120 patients with obesity were enrolled for this study. Complete physical and anthropometric examination was done to all patients by same paediatrician. Detailed history of patients regarding sociodemographic pattern, indoor and outdoor activity, food habit, birth weight, pattern of nutrition, duration of

breastfeeding and obesity, age at onset of obesity family history of obesity, cardiovascular disorder, cerebrovascular disorder and diabetes was noted.

Anthropometric measurement

For measurement of height we used Harpenden stadiometer and were measured to the nearest 0.1 cm. Weight measurement was done by electronic balance with light cloth and without shoes. It was measured to the nearest 0.1 kg. BMI was calculated by formulae body weight (kg)/square of height (kg/m²).¹³

For measurement of blood pressure we used ascultatory method for which sphygmomanometer and stethoscope was used and systolic blood pressure (SBP) and diastolic blood pressure (DBP) was based on the appearance and disappearance of Korotkoff sounds.

Regarding biochemical parameters plasma insulin was determined by using enzyme linked immunosorbent assay. Fasting insulin >15 $m\mu/l$ was considered hyperinsulinemia. Homeostasis model assessment-insulin resistance (HOMA-IR) was calculated by using this formula (FPI X FPG)/22.5.14 Score of more than 3.5 is taken as insulin resistance and score less than 3.5 as insulin sensitive. Routine enzymatic methods were used for the estimation of Plasma concentrations of total cholesterol, high-density lipoprotein (HDL)-cholesterol, low-density lipoprotein (LDL)-cholesterol, triglycerides and blood glucose.

International diabetes federation definition of MS was used as per that if three or more of the following criteria were present: BMI more than 95th percentile, triglyceride more than 40 mg/dl, HDL less than 40 mg/dl, fasting glucose more 110 mg/dl, systolic or diastolic BP more 90th percentile.¹⁵

Statistical analysis

Data were recorded in excel sheet and statistical analysis was done with software statistical package for social sciences (SPSS)-14 version. Qualitative data were calculated as percentage and proportions and were analyzed by Chi-square test. Quantitative data were expressed as mean±standard deviation (SD) and these data were analyzed by unpaired student t test. The p value less than 0.05 were taken as significant.

RESULTS

In present study as per enrolment criteria 120 over weight and obese children between 5 to 17 years of age were enrolled for this study. As per Table 1, out of 120 children enrolled 60 were female and 60 were male. The mean age of patient in male patients were 11.35±2.03 years and female patients were 10.74±2.58 years which was not significant statistically. There is significant difference in BMI in male and female child with obesity (28.23±3.28

versus 26.03±4.36). Fasting glucose and fasting insulin label were comparable to each other in both group (p more than 0.05). There is no significant difference between HOMA (IR) (3.54±1.54 versus 3.67±1.25) and HbA1c $(5.04\pm0.87 \text{ versus } 4.94\pm0.94)$ in two groups. Both group were comparable to each other with respect to plasma concentration of various lipid like TG (98.42±12.09 versus 99.75±13.19), HDL cholesterol (mg/dl) (40.9±4.08 versus 41.03±5.63) LDL cholesterol (mg/dl) (116.43±14.07 versus 117.40±16.24). There is significant difference in SBP in male and female child with obesity (109.9±12.54 108.4 ± 11.98). Regarding comparison anthropometric, metabolic and clinical parameter between patients with and without MS as per Table 2, out of 120 patients 36 (30%) were having MS and 84 were without MS. The mean age of patients in metabolic syndrome group was 12.46±2.75 years and in non-MS group it was 10.26±2.27 years. This difference was statistically significant. The BMI of patients in metabolic syndrome group was 29.25±1.25 kg/m² and in non-metabolic syndrome group it was 26.85±2.67 kg/m². This difference was statistically significant. Fasting glucose (94.34±12.36 mg/dl versus 89.65±10.84 mg/dl) and fasting insulin (18.65±13.64 mg/dl versus 16.48±10.32) was significantly higher in patients with MS than without MS (p is less than 0.05). HOMA (IR) was 5.84±1.43 in MS group and 4.54±1.34 in without MS group. The p value was 0.00. The glycocylated haemoglobin was significantly higher in MS

group than without MS group (5.84±0.78 versus 4.54±0.34). The plasma concentration of TG was 99.42±10.03 mg/dl in MS group and 89.78±11.69 mg/dl in without MS group. The plasma concentration of LDL was 134.84±14.07mg/dl in MS group and 110.50±17.64 mg/dl in without MS group, which significantly higher in MS group. The plasma concentration of HDL was 36.9±5.18mg/dl in MS group and 42.26±6.79 mg/dl in without MS group, which significantly lower in MS group. The mean of SBP was 110.9±10.78 mm of hg in MS group and 107.9±13.30 mm of Hg in without MS group, which significantly higher in MS group. *Acanthosis Nigricans* (*A. Nigricans*) was present in 18 patients in MS group and 4 patients in without MS group.

As per comparison of component of MS according to insulin resistance, out of 120 patient insulin resistance was found in 28 patients that is 23.3%. Impaired glucose tolerance test was present in 35.71% in insulin resistance and 2.27% in without insulin resistance patients. Triglyceride level was high in 71.43% but in without insulin resistance it was 34.78%. HDL label was low in 85.71% but in without insulin resistance it was low in 23.91%. Systolic BP (>95th) was high in 71.43% with insulin resistance and was high in 6.52% patients without insulin resistance. A. Nigricans was more common in insulin resistance group that is 57.14%.

Table 1: Comparison of clinical and biochemical parameter with respect to sex.

Variables	Male (n=60)	Female (n=60)	P value
Age (years)	11.35±2.03	10.74±2.58	0.21
BMI (kg/m2)	28.23±3.28	26.03±4.36	0.026
Fasting glucose (mg/dl)	90.45±10.65	91.48±12.78	0.28
Fasting insulin (μ/l)	16.63±6.24	15.73±4.96	0.14
HOMA (IR)	3.54±1.54	3.67±1.25	0.37
HbA1C	5.04±0.87	4.94±0.94	0.43
TG (mg/dl)	98.42±12.09	99.75±13.19	0.71
HDL cholesterol (mg/dl)	40.9±4.08	41.03±5.63	0.31
LDL cholesterol (mg/dl)	116.43±14.07	117.40±16.24	0.46
SBP (mm of Hg)	109.9±12.54	108.4±11.98	0.23

Table 2: Comparison of anthropometric, metabolic and clinical parameter between patients with and without MS.

Variables	MS (n=36)	Without MS (n84)	P value
Age	12.46±2.75	10.26±2.27	0.000
BMI (kg/m²)	29.25±1.25	26.85±2,67	0.000
Fasting glucose (mg/dl)	94.34±12.36	89.65±10.84	0.01
Fasting insulin (mµ/l)	18.65±13.64	16.48±10.32	0.04
HOMA (IR)	4.65±1.43	3.54±1.58	0.00
HbA1c	5.84 ± 0.78	4.54±0.34	0.023
TG (mg/dl)	99.42±10.03	89.78±11.69	0.012
HDL cholesterol(mg/dl)	36.9±5.18	42.26±6.79	0.03
LDL cholesterol (mg/dl)	134.84±14.07	110.50±17.64	0.024
SBP (mm of Hg)	110.9±10.78	107.9±13.30	0.21
Acanthosis Nigricans	18	4	

Table 3: Comparison of component of MS according to insulin resistance.

Variable	With insulin resistance (n=28) (%)	Without insulin resistance (n=92) (%)
Impaired GTT	10 (35.71)	2 (2.17)
TG	20 (71.43)	32 (34.78)
HDL	24 (85.71)	22 (23.91)
Systolic BP (>95 th)	20 (71.43)	21 (22.83)
A. Nigricans	16 (57.14)	6 (6.52)

DISCUSSION

In present cross sectional descriptive study we have evaluated clinical, metabolic and biochemical parameters for detection of prevalence of MS in obese and overweight children. In our study the prevalence of MS was 30% among obese and overweight children. We have used International diabetes federation (IDF) definition of metabolic syndrome for diagnosis of metabolic syndrome. Sangun et al has concluded that prevalence of MS was found to be 33% according to the IDF consensus criteria which support our study. Gupta et al has reported that overall prevalence in general paediatric population was 3.3% but Andrabi et al has concluded that paediatric MS was more common in obese patient than in normal population that is 30.7% versus 2.5% which support our study. The state of the support our study.

Clinical and biochemical parameter with respect to sex are comparable to each other in our study except BMI which was significantly higher in male obese patients. This observation is supported by the study of Sangun et al. 16 Anthropometric parameters were significantly higher in MS group than without MS group. This finding corroborates with the finding of Bluher et al and Agirbasli et al. 19,20 Fasting glucose and glycocylated haemoglobin was high and there were features of insulin resistance like increased HOMA (IR) and plasma insulin label in patients with MS. Our finding is supported by the work of Yin et al and Kurtoglu et al.^{21,22} Metabolic parameters like TG, LDL significantly high and HDL was significantly low in MS patients and A. Nigricans was common among MS patients. Cook et al has concluded that children with the highest BMI-SDS and lowest physical fitness have the lowest HDL-C values and increased TG, indicating a higher risk for the metabolic syndrome which support our study.²³ Study of Korsten-Reck et al also support our finding.²⁴ Jinkyung et al has concluded from his study that IR is significantly associated with the clustering of MetS risk factors.²⁵ Kostovski et al has concluded that insulin resistant obese children and adolescents tend to have a worse metabolic profile in comparison to individuals without insulin resistance.²⁶ Above two studies support our finding.

CONCLUSION

From our study we can conclude that MS is a common problem in children with overweight and obesity in our region. There is no difference between male and female child regarding biochemical profile. Insulin resistance and metabolic abnormality were more common in children with MS.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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