Original article:

Prevalence of T2DM and Metabolic Syndrome among School Going Obese Children and Adolescents in North India: A Cross Sectional Study

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Abstract

Introduction: The aim of this study was to investigate the prevalence of metabolic syndrome, in children with type II diabetes mellitus (T2DM) in population of North India.

Materials and Methods: The inclusion criteria were, age of < 17 years, Subjects were classified as children (6-9 years) or adolescents (10-17 years). Fasting blood sugar (FBS) > 125 mg/dL or random blood sugar _ 200 mg/dL along with the presence of diabetes symptoms (e.g. polyuria and polydipsia), and insulin dependency for controlling blood sugar in the normal range

Results: The mean age of the 72 boys and 98 girls who participated in the study was 14.4 and 12.11 years. 40.11% were overweight and 74% were obese. There was no significant difference between the prevalence of obesity in different genders (P = 0.422). Also metabolic syndrome did not have a significant association with the type of insulin regimen (P = 0.68), nor the daily dosage of insulin (P = 0.98), however the serum concentration of HbA1c had a significant correlation with metabolic syndrome (P = 0.021).

Conclusion: This study provides evidence showing poor glycemic control and high prevalence of metabolic syndrome in children with T2DM in North India.

Keywords: Type II Diabetes Mellitus, Metabolic Syndrome, Obesity.

INTRODUCTION

The metabolic syndrome is considered as a major risk factor for cardiovascular disease and type 2 diabetes. Components of metabolic syndrome are present in children and adolescents, as well as in adults.[1] However, the metabolic syndrome has not been well characterized in children or adolescents in terms of criteria, prevalence, or clinical implications, although studies have examined abnormalities caused by the metabolic syndrome.[2,3]

Obesity plays a central role in the metabolic syndrome, which includes hyperinsulinemia/insulin resistance, hypertension and dyslipidemia. Recent studies indicate that the process of atherosclerosis starts at an early age and is already linked to obesity and other components of the

metabolic syndrome in childhood.[4] Parallel with the obesity epidemic, the incidence of type 2 diabetes mellitus in children has increased alarmingly and the presence of the metabolic syndrome in children and adolescents has also been reported.[5]

The incidence of overweight children and adolescents has been increasing in Asia with urbanization and economic development.[6] Obesity is associated with dyslipidaemia, type 2 diabetes mellitus and long-term vascular complications.[7-9]

MS in children and adolescents has been linked to hostile intrauterine environment leading to intrauterine growth retardation, low birth weight and small for gestational age.[10,11] Other factors can be genetic, socio-economic, environmental (obesogenic environment), urbanization, unhealthy diet and increasingly sedentary lifestyle.[12,13] Obese children with metabolic syndrome are at increasing risk of progressing to type 2 diabetes and cardiovascular disease in later life.[14] Early identification of children at risk and preventive action are therefore very important. However, to date, no unified definition exists to assess risk or outcomes in children and adolescents, and existing adult-based definitions of the metabolic syndrome are not appropriate to address the problem in this age group. This disagreement in proposing a unified definition mainly results from the difficulty in establishing cutoff points due to the absence of clinical manifestations of cardiovascular diseases in childhood.[15]

Although type 1 diabetes remains the main form of diabetes in the young, the much less common, inherited forms of diabetes, and type 2 diabetes mellitus (T2DM) can also present in early life. T2DM in children and adolescents is regarded as an emerging problem; however, there are only few reliable reports of its true population prevalence or its prevalence in obese children. Population-based data suggest that the epidemic of pediatric obesity is being followed by an increase of the incidence and prevalence of type 2 diabetes mellitus. The aim of this study was to investigate the prevalence of metabolic syndrome, in children with type II diabetes mellitus (T2DM) in population of North India.

MATERIALS AND METHODS

This was a cross-sectional study on all children with T2DM, whom were referred to the pediatric department of TeerthankerMahaveer Hospital between July 2017 and October 2017. The present study conducted in 170 children (72 females and 98 males). Written informed consent was obtained from the parents of the participants, and oral consent was required from each child. All procedures followed were approved in accordance with the guidelines of the ethical committees of the TeerthankerMahaveerMedical College, Hospital and Research Centre.

The inclusion criteria were, age of < 17 years, Subjects were classified as children (6-9 years) or adolescents (10-17 years). Fasting blood sugar (FBS) > 125 mg/dL or random blood sugar 200 mg/dL alongwith the presence of diabetes symptoms (e.g. polyuria andpolydipsia), and insulin dependency for controlling blood sugar in the normal range.

We excluded all children with diabetes who had aknown chronic liver disease, congenital heart disease and chronic kidney diseases.

Fasting blood glucose and lipids were measured after overnight fasting. Fasting blood sugar (FBS) was measuredby the enzymatic colorimetric method using glucose oxidase test.

All subjects underwent anthropometric assessment like measurement of height, weight, Body mass index (BMI), waist circumference (WC) and measurement of blood pressure. Body weight was measured by an electronic scale (Filizola) to the nearest 0.1 kg while the school children were barefoot and wearing light clothes. Height was determined by a portable Secastadiometer to the nearest 01.cm, according to norms proposed by the World Health

Organization (WHO, 1995).[3] BMI (weight in kilograms divided by the squared height in meters) was calculated by using the measured height and weight and converted to percentiles for age in months and gender by using the Center for Disease Control and Prevention (CDC, 2000) growth charts and computer software Epi-Info version 3.2 (2004).[14] Indian BMI Percentiles were used to classify children in different classes.[16]WC was measured midway between the rib cage and the superior border of the iliac crest by using a milli-metric non-extensible and nonelastic measuring tape in midrespiration and inferences were drawn in percentiles. Blood pressure was measured by the mercury sphygmomanometer method after the child had been sitting at rest for a minimum period of 5 minutes, and the cuff involved 80% of the right arm's circumference.

Data are presented in the form of descriptive statistics produced using SPSS 21.0, and Metabolic syndrome prevalence rate were calculated according to each of the four proposed classifications (MS1 to MS4) and differences between proportions were calculated to a significance level of 0.05.

RESULTS

In this study,170 children with diabetes (72 females and 98 males) aged 12.48± 8.2 were enrolled. (21.8%) children had family history of diabetes mellitus. (5.2%) boys were cigarette smokers. Eighty one percent, of patients had positive results for glutamic acid decarboxylase, islet-cell-antibody and insulin auto anti body. High blood sugarwas controlled with insulin regime of NPH twice daily added to regular insulin. Others were controlled with once daily Glargin and three times Aspart insulin per meal. Other general characteristics and biochemical variables are summarized in Table 1.

The mean age of the 72 boys and 98 girls who participated in the study was 14.4 and 12.11 years. 40.11% were overweight and 74% were obese. There was no significant difference between the prevalence of obesity in different genders (P = 0.422). Also metabolic syndrome did not have a significant association with the type of insulin regimen (P = 0.68), nor the daily dosage of insulin (P = 0.98), however the serum concentration of HbA1c had a significant correlation with metabolic syndrome (P = 0.021).

Table 1: Criteria of Metabolic Syndrome in our Patients

Variable	Male (72) Mean±SD	Female (98) Mean ±SD
Age	14.5	12.11
Duration of DM	4.2±1.7	2.34±5.1
Insulin/kg	0.68±0.63	0.75±0.18
Weight	37.24±16.2	39.41±14.92
Height	141.2±17.3	137±13.9
BMI	17.8±3.28	18.42±3.21
Diastolic BP	64.7±7.9	63±4.7
Systolic BP	108±10.2	106±11.1
Hba1c	11.2±4.26	9.28±5.65
Age - onset of DM	6.5±3.4	6.3±2.56

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Waist circumference	76.2±8.4	71.34±7.88
HDL	43.7±10.8	46.65±13.9
LDL	79.3±28.9	78.243.8
TG	121.1±54.2	120.32±46.6
Total cholesterol	152.6±3.28	146.9±32.9
Metabolic Syndrome	14 (8.23)	9 (5.29)

DISCUSSION

This study was conducted on 170 children with T2DM in North India.The prevalence of Metabolic Syndrome in the present study according to the modified ATP III criteria was 13.52% of the studied obese children.

Drake et al[17] from Bristol, UK, reported four white adolescents who presented with T2DM associated with significant obesity (BMI (kg/m2)4þ3 SDS). Three of them were female and two had acanthosisnigricans and a family history of diabetes. In an Italian study[18] based on 710 grossly obese children and adolescents of European origin, the prevalence of T2DM and IGT was 0.1 and 4.5%, respectively. Wabitschet al[19] have recently published a report on the prevalence of T2DM and impaired glucose regulation in Caucasian obese children living in Germany. T2DM was present in eight (1.5%) of the patients examined. All of them were in the pubertal age and male to female ratio was 1:3. Analysis of the multicenter database from 148 pediatric diabetes centers from Germany and Austria[20] revealed 130 (0.6%) children of Caucasian origin with T2DM compared to 19 796 patients with diabetes type 1. Patients with T2DM were predominantly female, significantly older at the diagnosis and more overweight as compared to those with type 1 diabetes mellitus.

Including total cholesterol as a variable in the diagnostic criteria for MS resulted in a similar prevalence to the MS4 criteria that were based on the NCEP/ATPIII classification for adults,[21] but with more sensitive cutoff points. The high prevalence of hypercholesterolemia (97.3%) was the result of inclusion criteria with a low cutoff point, as recommended by the SBC.[22] Although cholesterol is not considered a criterion for MS, its inclusion is particularly important in the target-population, because of the effect on the process of atherosclerosis.

Two studies[23,24]were conducted in Turkey using the MS3 criteria and the observed prevalence of MS was 27.2 and 41.8%, but some of the cutoff points were altered, which may have affected the estimates.

Population-based data on type 2 diabetes among children and adolescents are unavailable from India. However migrant studies from high-income countries have demonstrated a high prevalence of type 2 diabetes among south Asian adolescents.[25] Isolated clinic-based studies from India report a consistent increase in the proportion of individuals with type 2 diabetes among adolescents. A clinic-based study from Chennai reported that 30.4% of individuals diagnosed with diabetes at a young age who were registered at their centre during 1992–1995 had type 2 diabetes.[26] This increased to 49.1% during 2006–2009.[26] Out of the total 5546 patients recruited (between 2000 and 2011) by the large clinical registry of youth-onset diabetes funded by the Indian Council of Medical Research, 25.3% were diagnosed as having type 2 diabetes (unpublished data). However, results from these clinic-based studies should be interpreted with caution, as they could be influenced by referral bias.

CONCLUSION

This study provides evidence showing poor glycemic control and high prevalence of metabolic syndrome in children with T2DM in North India. More studies should be conducted in Asian countries. Also, further studies should be undertaken to show the pathophysiology of metabolic syndrome in T2DM. Also, preventive programs aimed toward decreasing the risk factors of metabolic syndrome and interpretation of a healthier diet and physical activity for children withT2DM should be considered in our country.Although type 2 diabetes mellitus is still rare among Indian children, screening is recommended for type 2 diabetes mellitus or impaired glucose tolerance in children and especially in adolescents with substantial risk for the development of this disease.

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