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Original Article

Metabolic derangements and its association with the level of physical activity in obese and overweight children aged 8-14 years at Teaching Hospital, Jaffna

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Abstract

Childhood obesity is a rapidly growing nutritional disorder in children. Metabolic derangements are a common problem encountered in these children. Research has shown the relationship between dietary intake and metabolic derangement. We undertook this study to see the relationship between metabolic derangements and the level of physical activity.

We aimed to assess the relationship of metabolic derangements and the level of physical activity among obese and overweight children.

A hospital-based descriptive cross-sectional study was done in outpatient Paediatric clinics at the Teaching Hospital Jaffna. Children aged 8- 14 years with BMI above + 1SD were included in this study. The pattern of physical activity was assessed using a Physical Activity Questionnaire-S. Anthropometric measurements were taken using standard procedures and details of the laboratory investigations were obtained from the clinic record done within the immediate past six months.

A total of 280 children were included. Nearly two-thirds of children were obese 63.9% (n-178), and 8.6% (n-24) and 2.9% (n-8) of children have impaired glucose and DM respectively; 23.2% (n-64) of the children had equal or more than 90th centile diastolic blood pressure, and 35% (n-98) had equal or more than 90th centile systolic blood pressure and waist circumference. Insufficient physical activity was seen in 44.3% (n-124) and 13.2% (n- 37) of these children had metabolic syndrome.

BMI and metabolic derangement showed a statistically significant correlation with the activity level of a child

Keywords

overweight, obese, children, metabolic derangement, activity level

Introduction

Globally, around 170 million children below 18 years are now estimated to be overweight (1). Sri Lanka, as a developing country, faces a double burden of obesity as well as undernutrition. In recent years due to the socio-economic transition, the prevalence of obesity has gone up in developing countries such as Sri Lanka.

According to International Diabetes Federation (IDF), metabolic syndrome is defined in children aged >10 years as having >3 of the following criteria: Fasting blood glucose 5.6 mmol / L (≥100 mg / dL), waist circumference more than 90th centile for sex / age, blood triglycerides level ≥1.7 mmol /L (≥150 mg / dL), systolic or diastolic blood pressure ≥90th centile for height and age and HDL cholesterol 1.03 mmol/L (≤40 mg/dL) (2,3).

Regular physical activity is one of the treatment strategies of obesity. In 2010, WHO, Global guidelines recommended moderate to vigorous daily physical activity for 60 minutes for 5–17-year-old children (4). A community-based cross-sectional study was done among healthy children attending school in Jaffna districts to screen for metabolic syndrome among school children, shows 6.3% were obese. 11% were overweight. Metabolic syndrome was seen in 9% of the children. The metabolic syndrome shows a significant association with central obesity and overweight (5).

Research related to metabolic syndrome and its importance with healthy life style in children is very important for recognizing target groups of children

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and adolescents to target interventions and life style modifications. There were no studies on the independent association of physical activity with metabolic syndrome among obese and overweight children.

Main aspects of managing obesity are restricting energy intake and increasing physical activity. If there is an independent association between the level of physical activity with metabolic syndrome, the impact of metabolic derangements can be reduced by improving the level of physical activity along with minimal dietary modification. Thus, we have done a study to assess the relationship between metabolic derangements, and the level of physical activity among obese and overweight children.

Methods

A hospital-based descriptive cross-sectional study was done in the paediatric outpatient clinics at the Teaching Hospital Jaffna. All the patients aged 8- 14 years who had body mass index above 1st standard deviation for age and gender attending the clinic during the study period were included in this study. Children with chronic illness were excluded from the study. The sample size was calculated using the standard method and it was 280.

A pretested, predesigned interviewer-administered questionnaire was used to collect the socio-demographic details, anthropometric measurements, blood pressure and waist circumference were measured by trained investigators. Clinic records were observed for details of metabolic derangements in the previous 6 months. The pattern of physical activity was assessed using a Physical Activity Questionnaire-S (PAQ-S), which was validated for Sri Lankan children (6). The informed consent and assent were obtained from all the parents or guardians and from the child prior to the data collection.

SPSS 27.0 (IBM Corp., Armonk, N.Y., USA) was used for all analyses. Descriptive statistics were used to present baseline data. Continuous variables are presented as mean with standard deviation (±SD) and categorical variables are presented as frequencies and proportions. Statistical association was done using Chi squared test with 95% confident interval and the corelation test was performed using Pearson corelation two tailed tests.

Ethical approval was received from Ethics Review Committee (ERC) of Faculty of Medicine, University of Jaffna, Sri Lanka. (Reference number J/ERC/19/111/DR/071).

Results

A total of 280 eligible children were included with the mean age of the children was 10.74 (+/-1.73) years. Majority of children were male (55%, n=154) and Hindus 83.6% (n-234) and studying in Government school 74.6% (n=209)

Considering the birth related factors among the children, 18.9% (n-53) were preterm (below 37 weeks) and 18.6% (n-52) low birth weight (below 2.5Kg) and more than 80% (n-228) were exclusively breast fed. The mean of monthly income was Rs 38,985/= (+/-17,904.6). Nearly two third of mothers and fathers studied up to A/Level.

Family history of obesity in fathers, mothers and siblings was seen in 10% (n-28), 12.5% (n-35) and 4.3% (n-12) respectively. Forty-five (16.4%) mothers had pre-pregnancy obesity and 6.4% (n-17) had gestational diabetes.

Activity level was assessed using validated PAQ – S tool; 44.3% (n-120) of children have insufficient activity level. Typical duration of play and leisure activity in a week among children was assessed using Likert time interval. Nearly 40% *(n-112)* of children spent 3 to 4 hours in a week watching TV; Nearly three-quarters of children spent more than an hour playing computer/video games; nearly two third listened to music less than an hour; more than quarter spent 3 to 4 hours in a day talking/chatting on the phone. Mean sleeping hours in the day and night time were 0.42 Hours (+/- 0.74) and 7.95 Hours (+/- 0.83) respectively.

Anthropometric measurements were measured during the data collection, mean value of weight, height, waist circumference, systolic and diastolic blood pressure were 51.57 (+/- 11.89) Kg, 149.69 (+/- 10.01) cm, 76.92 (+/- 8.21) cm, 109.9 (+/- 9.08) mmHg, and 69.16 (+/- 8.61) mmHg respectively. The mean FBS, serum cholesterol and HDL were 84.77 (+/-19.63) g/dL, 4.07 (+/-0.73) (mmol/L) and 1.65 (+/-2.46) (mmol/L) respectively. (Table 1)

Table 1: Clinical and metabolic parameters of the population

Parameters	Mean± Std. Deviation
Weight (Kg)	51.57±11.89
Height (Kg)	149.69±10.01
Waist circumference (cm)	76.92±8.21
Systolic pressure (mmHg)	109.9±9.08
Diastolic pressure (mmHg)	69.16±8.61
FBS (g/dL)	84.77±19.63
Serum cholesterol (mmol/L)	4.07±0.73
Serum triglyceride (mmol/L)	1.13±0.58
HDL (mmol/L)	1.65±2.46
LDL (mmol/L)	2.26±0.64
AST (mmol/L)	31.23±12.13
ALT (mmol/L)	40.48±19.14

Nearly two third of children were obese 63.9% *(n-178)* and 8.6% (n-24) and 2.9% *(n-8)* of children have impaired glucose and DM, respectively; 23.2% (n-64) of the children have equal or more than 90th centile diastolic blood pressure and 35% (n-98) have equal or more than 90th centile systolic blood pressure and waist circumference. Metabolic syndorme (MetS) defined by IDF criteria was seen in 36(13.2%) of the children (Table 2)

Table 2: Metabolic-related outcomes among the children

Level of metabolic-related outcomes	Frequency (n)	Percentage (%)
Diastolic centile		
>=90th centile	65	23.2
<90th centile	215	76.8
Systolic centile		
>=90th centile	98	35.0
<90th centile	182	65.0
Waist circumference centile		
>=90th centile	98	35.0
<90th centile	182	65.0
BMI centile		
>=+2SD	179	63.9
>=+1SD	101	36.1
STGA level		
>=1.7	37	13.2
<1.7	243	86.8
HDL level		
<=1.03	80	28.6
>1.03	200	71.4
LDL range		
Normal	230	82.1
Borderline	30	10.7
High	20	7.2
FBS range		
Normal	248	88.6
Impaired	24	8.6
DM	8	2.9
Serum TG level		
Normal	215	76.8
Borderline	48	17.1
High	17	6.1
Activity level		
Insufficient	124	44.3
Sufficient	156	55.7
Metabolic derangement		
Have metabolic derangement	37	13.2
Not having metabolic derangement	243	86.8

Chi squared was used to assess the statistical association on MetS and socio-demographic features and birth related factors which showed no statistical correlation.

Statistical association on MetS and activity level of a child demonstrated that PAQ – S activity level was statically significant. (Table 3)

Table 3: Correlation between activity level and MetS among children

		PAQC score	MetS
PAQC score	Pearson Correlation	1	225**
	Sig. (2-tailed)		.000
	N	280	280
MetS	Pearson Correlation	225**	1
	Sig. (2-tailed)	.000	
	N	280	280

**. Correlation is significant at the 0.01 level (2-tailed).

Pearson productive correlation of physical activity level and metabolic derangement showed a positive correlation ($r = 0.225$, $p < 0.001$). (Table 4)

Table 4: Correlation between BMI centile and MetS

		BMI centile	MetS
BMI centile	Pearson Correlation	1	0.139*
	Sig. (2-tailed)		.020
	N	280	280
MetS	Pearson Correlation	0.139*	1
	Sig. (2-tailed)	.020	
	N	280	280
*. Correlation is significant at the 0.05 level (2-tailed).			

Pearson productive correlation of BMI and metabolic derangement was found to be positive correlation ($r = 0.139$, $p < 0.005$). This shows an increase in BMI centile (Obesity) would lead to the risk of metabolic derangement among the children. Results revealed that, obese children have high risk of getting metabolic derangement than the overweight children.

Discussion

Study showed that nearly two-third of children were obese whereas one-third were overweight. Impaired glucose was seen in 8.6% (n-24) and diabetes in 2.9% (n-8) of children. Warnakulasuriya *et al* described the distribution of metabolic abnormalities among 7 to 17 years old overweight and obese children in the Gampaha District of Sri Lanka; Of the study population, 83.6% (n-234) were obese and 16.4% (n-45) were overweight; Dysglycaemia was seen among 20.8% (n-58) which is higher than our population (8).

Time spent on different types of play activities and hobbies among the children in a typical day showed that, 44.3% (n-124) of children were having insufficient activity level; further, nearly 40% (n-112) of children spent 3 to 4 hours in a day watching TV and more than quarter spent 3 to 4 hours in a day, talking/ chatting on phone. This showed an excessive sedentary habit may lead to obesity and related complications.

It was observed that 13.2% (n-36) of the children have MetS. In the study done by Warnakulasuriya *et al* MetS was seen in 19.8% (8). It is relatively very high than the normal population where it is seen in 1.7% (9).

Current study showed that, there is no statistically significant correlation between MetS and selected socio-demographic factors and birth-related factors. However, activity level is statistically significant with the MetS ($p = 0.001$). A study done by Gunawardana *et al* to assess physical and psychosocial quality of life in Sri Lankan children attending a specialized obesity clinic, showed that, physical quality of life inversely correlated with BMI (10). A study done by Kelishadi *et al* to assess association between physical activity and the metabolic syndrome showed that prevalence of MetS was higher in less active children which was independent of body mass index and age. Therefore, children should be encouraged to have greater physical activity. (11).

Further, person corelation demonstrated obese children have more chance of getting MetS than overweight children ($r = 0.139$, $p < 0.005$).

Thus, this study warrants active screening of the child population, especially those who are having poor activity levels and sedentary lifestyle habits to prevent obesity and related comorbidities. In addition, the study suggests that a periodical assessment of metabolic derangement and related parameters will be beneficial among the risk group children. Furthermore, reaching a consensus on diagnostic techniques for MetS and creating awareness about these conditions among the medical fraternity as well as the general public is of paramount importance.

Conclusion

In conclusion, the study clearly shows that the prevalence of MetS among obese and overweight Sri Lankan children starts from a very young age. Obesity is highly associated with metabolic derangement, and both BMI and metabolic derangement are statistically correlated with the activity level of a child. Further, results demonstrated that insufficient activity level is highly associated with metabolic derangement and risk of obesity.

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