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RESEARCH ARTICLE

METABOLIC RISK FACTORS AMONG 9-12 YEAR OLD CHILDREN OF COCHIN

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ABSTRACT

Objectives: To assess the nutritional status of school going children on the basis of anthropometric, biochemical and dietary variables, To estimate the incidence of overweight and obesity, To study the metabolic risk factors in the subjects by weight status.
Methods: Sixty three nine to twelve year old children were purposively selected from two urban schools in Ernakulam district, Kerala and based on BMI percentiles the subjects were broadly classified into non overweight and overweight respectively. The subjects were assessed for the risk of the metabolic components proposed by American Dietetic Association (ADA, 2004*)* and categorized in to normal and high risk respectively.
Results: The result of the study reveal that majority of the overweight subjects had increased levels of all investigated risk factors compared to non overweight subjects. Serum insulin and systolic blood pressure show a highly significant correlation ($p<0.001$) with weight status. The overall metabolic risk of subjects by weight status shows that 66.7 percent of the overweight children had clustering of one or two risk factors of metabolic syndrome when compared to 46.3 percent of non overweight subjects.
Conclusions: The frequency of clustering of metabolic risk factors is higher among the overweight subjects compared to their non overweight counterparts.

INTRODUCTION

The rapid economic development along with an increased urbanization and impact of market globalization over the last decades has brought about considerable changes in diet and lifestyle of the people all around the world. Changes in the world food economy are reflected in shifting dietary patterns like increased consumption of energy dense diets high in fat- particularly saturated fat- and low in unrefined carbohydrates. These patterns are combined with a decline in energy expenditure that is associated with sedentary lifestyle (WHO/FAO, 2003). It is believed that these changes in dietary and lifestyle patterns are the major factors for increasing the prevalence of obesity associated with non communicable chronic diseases such as diabetes mellitus, cardiovascular disease, hypertension and stroke (Khongsdier, 2005). The metabolic syndrome has been defined as cluster of most dangerous risk factors for cardiovascular diseases and type 2 diabetes which included abdominal obesity, high cholesterol, high blood pressure, and raised fasting plasma glucose (Alberti *et al.,* 2005). Already, a quarter of the world's adult population has metabolic syndrome and this condition is appearing with increasing frequency in children and adolescents due to the growing obesity epidemic within this young population (Weiss *et al.,* 2004). As a major risk factor for chronic disease, the metabolic syndrome is rapidly increasing in prevalence with raising childhood obesity and sedentary lifestyle. In western countries, the incidence of childhood obesity has more than doubled over the past generation, as a consequence, the prevalence of metabolic syndrome and type 2 diabetes mellitus is rapidly increasing in pediatric population (Cook *et al.,* 2003). Children with metabolic syndrome are two to three times as likely to have a heart attack or stroke and five times as likely to develop type 2 diabetes in their later life compared with children without the syndrome. The risk factors associated with metabolic syndrome in children can be extended to adulthood and causes many cardiometabolic complications. So early identification of children at risk of metabolic syndrome will be crucial to the prevention of chronic disease during childhood and in later life (Zimmett, 2007).

MATERIALS AND METHODS

The study was conducted in two private schools of Ernakulam, namely Bhavans Vidya Mandir and Amrita Vidyalayam. From the two schools with parental consent, 63 healthy children (39 boys and 24 girls) between the ages of nine to twelve years were recruited for the study. The two urban schools were selected by convenience sampling; the sub sampling was done by voluntary presentation for a blood draw in the prescribed age group after dissemination of the study

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information. Children with systemic illness or on medication were not included in the study. The tools for the study included interview schedule and questionnaire. Details such as dietary habits, socioeconomic background were collected using the interview schedule. Data on three (consecutive) day dietary intake was collected using a questionnaire on 24 hours dietary recall. The overall nutritional status of the subjects under study were assessed using anthropometric measurements such as height, weight, body mass index, mid upper arm circumference, waist hip ratio, body fat percentage and skinfold thickness. Based on the BMI percentiles the subjects were broadly classified into two groups namely non overweight and overweight respectively.

Biochemical parameters were assayed by trained personnel in certified labs Anthropometric Measures Body Mass Index(BMI), Mid Upper Arm Circumference (MUAC),Waist Hip Ratio(WHR) and Skin Fold Thickness(SFT). The blood pressure was measured using a standardized mercury sphygmomanometer and recorded by a trained nurse, Serum Insulin assay was done by chemiluminescence method to reduce the chance of erroneous variable, and Fasting Blood Glucose (FBG) was measured using Photometric method. The Lipid profile was assayed using spectrophotometric method using the instrument Olympus 2700. Lipid profile included total cholesterol (TC), High density Lipoprotein cholesterol (HDL-C), Trigylceride (TG), Low density lipoprotein cholesterol (LDL-C) and very low density lipoprotein cholesterol (VLDL-C). Nutritive value of the diet was computed by referring to Nutrient Data base released by ICMR and USDA. Thus, energy, protein, fat, carbohydrate, fiber and fat composition of the diet was calculated. Then the subjects were studied for the risk of the metabolic components proposed by American Dietetic Association (ADA, 2004) given in Table (1) and categorized in to normal and high risk.

Table 1. Definitions of risk for metabolic components

Component	Risk Category definition
BMI	Not at risk : <85th percentile Overweight: ≥ 95th percentile
HDL cholesterol	Normal > 35 mg/dL Low : ≤ 35 mg /dL
Triglycerides	Normal : ≤110 mg/dL High : >110 mg/dL
Insulin	Normal: <15 µU/L High : >20 µU /L
Glucose	Normal : <100 mg/dl Impaired fasting glucose: 100-125mg/dL
Systolic blood pressure	Normal: <90th percentile Hypertension: ≥ 95th percentile
Diastolic blood pressure	Normal: <90th percentile Hypertension: ≥ 95th percentile

Reference: American Diabetic Association (2004)

The data obtained was subjected to appropriate statistical analysis (SPSS 11.0 Version) like Pearson's correlation co-efficienct and 't' test and the results were interpreted to reach the study objective.

RESULTS AND DISCUSSION

On assessing the weight status of subjects, although a vast majority (86 percent) belonged to non overweight category, Fourteen percent were overweight. Gender based segregation of subjects revealed a higher prevalence of overweight among girls at 21 percent compared to boys at 10.3 percent.

Table 2. Anthropometric parameters of subjects by weight status

N=63

Anthropometric parameters	*Means (SD)*		*t value*
	Non overweight	Overweight	
Height (cm)	141.6 (9.8)	148.4 (9.7)	1.922*
Weight (kg)	33.6 (7.7)	51.5 (10.8)	6.050**
BMI (kg/m^2)	16.6 (2.3)	23.1 (2.4)	7.569**
Waist (cm)	62.8 (7.4)	79.9 (8.6)	6.245**
Hip(cm)	73.3 (5.3)	88.5 (5.7)	6.567**
WHR	.857(.044)	.906 (.057)	3.758**
Sum of skin folds (mm)	36.1 (14.5)	65.3 (15.9)	5.513**
MUAC(cm)	19.7 (3.9)	25.8 (4.1)	4.452**
Body fat percentage	20.5 (3.1)	26.6 (3.56)	2.231*

***Highly significant; *significant*

Table 3. Biochemical parameters of subjects by weight status

N=63

Biochemical parameters	*Means (SD)*	
	Non overweight	Overweight
Systolic BP (mmHg)	90 (8.6)	113.7(11.6)
Diastolic BP (mmHg)	65.9 (7.2)	75.5 (6.3)
Serum Insulin (µU/L)	7.5 (4.6)	19.8 (15.0)
Fasting Blood glucose(mg/dl)	90 (5.9)	94 (7.8)
*Apo A (mg/dL)**	126.1 (18.5)	125.4 (15.6)
*Apo B (mg/dL)**	83.1 (20.2)	78.7 (11.7)
T-Cholesterol (mg/dL)	184.9 (33.5)	179 (17.2)
*HDL (mg/dL)**	49.3 (8.9)	46 (8.1)
*LDL (mg/dL)**	109.4 (22.6)	106.7 (15.3)
*VLDL (mg/dl)**	17.9 (7.8)	24.2 (4.0)
*TG (mg/dl)**	94 (44.6)	120.8 (58.4)
*CRP (mg/L)**	1.3 (6.0)	2.9 (4.4)

*Apo A-Apo lipoprotein A, Apo B-Apo lipoprotein B,HDL-High Density lipoprotein, LDL-Low Density Lipoprotein, VLDL-Very Low Density Lipoprotein, TG-Triglycerides, CRP-C-Reactive Protein.

Table 4. Nutrient intake pattern of subjects by weight status

N=63

Nutrients	*Means (SD)*	
	Non overweight	Overweight
Energy (Kcal)	1718.5 (220.6)	1776.5 (267.6)
Protein (g)	47 (9.8)	47.4 (10.5)
Carbohydrates (g)	260.7 (40.6)	280.5 (46.9)
Fat (total) (g)	52.3 (7.8)	52.5 (6.5)
Visible fat(g)	29.8 (5.5)	29.6 (7.9)
*SFA (g)**	37.3 (8.9)	35.4 (10.3)
*MUFA (g)**	8.6 (2.5)	8.5(2.6)
*PUFA(g)**	5.1 (4.1)	5.9 (6.7)
Fiber (g)	3.6 (.98)	3.9 (1.1)

*MUFA-Mono Unsaturated Fatty Acid, PUFA-Poly Unsaturated Fatty acid SFA-Saturated Fatty Acid

Table 5. Distribution of metabolic risk by weight status

N=63

Risk components	*Non overweight*		*Overweight*	
	Normal (%)	High (%)	Normal (%)	High (%)
Triglycerides (mg/dL)	76	24	44	56
Insulin (µu/L)	92	8	44	56
Fasting blood glucose (mg/dL)	69	31	67	33
Systolic blood pressure (mmHg)	100	-	67	33
Diastolic blood pressure (mmHg)	89	11	44	56

Anthropometric data of the subjects by weight status Table (2) shows a significant increasing trend with increasing BMI percentiles in the study population and also the independent test shows a significant difference between overweight and

non overweight groups. The biochemical profile of the subjects by weight status depicted in Table (3) shows that the systolic and diastolic blood pressure were gradually escalating from non overweight to overweight subjects, the increase being more evident for systolic blood pressure. Serum insulin level was observed to be low in non overweight subjects, compared to overweight subjects. Interestingly, triglyceride levels and C-reactive protein also increased progressively from non overweight to overweight subjects.

Table 6. Pearson's correlation coefficient for metabolic risk with weight status

N=63

Parameters	*Weight status*		*P values*
	Non overweight Means ± SD	Overweight Mean ± SD	
TG (mg/dL)	94 ± 44.6	120.8± 58.4	.109
Insulin (µU/L)	7.5 ± 4.6	19.8± 15.0	. 006*
FBG (mg/dL)	90 ± 5.9	94± 7.8	. 033
SYS – BP (mmHg)	90± 8.6	113.7± 11.6	.000*
DIA – BP (mmHg)	65.9 ± 7.2	75.5 ± 6.2	.001*

TG-Triglycerides, FBG-Fasting Blood Glucose; *Significance <0.001
SYS-BP-systolic Blood Pressure, DIA_BP-Diastolic Blood Pressure

On studying the nutrient intake pattern of the subjects by weight status Table (4), energy and carbohydrate intake was seen to be gradually escalating from non overweight to overweight subjects. The mean energy intake is high (1776.5 Kcal) in overweight subjects than non overweight subjects (1718.5 Kcal) and there is a difference of 58Kcal between two groups. The difference is only marginal, and it may be explained by the fact that some of the overweight subjects had already initiated downsizing their portion size and there was some under reporting too. Protein and fat intake was observed to be similar for both groups. The Table (5) shows the distribution of metabolic risk factors of subjects stratified by weight status. It is evident from the table that, compared to non overweight subjects majority of the overweight subjects had higher incidence of metabolic risk factors like elevated serum triglycerides, insulin, fasting blood glucose and systolic and diastolic blood pressure.

On analyzing the serum triglyceride and insulin levels of the subjects by weight status, it was found that 56 percent of overweight subjects had high level when compared to 24 and 8 percent respectively of non overweight counterparts. The fasting blood sugar levels of subjects shows that 33 percent overweight subjects had high level when compared to 31 percent of non overweight subjects. The blood pressure components of study subjects show that a greater number of overweight subjects (33 and 56 percent) had high level of systolic and diastolic blood pressure when compared to (zero percent and 11 percent) of non overweight subjects. On analyzing the overall metabolic risk factors of study subjects by weight status, it reveals that 66.7 percent of the overweight children had clustering of one or two risk factors of metabolic syndrome when compared to 46.3 percent non overweight subjects. Table (6) depicts Pearson's correlation of metabolic risk factors with weight status. It shows that only the insulin levels and systolic and diastolic blood pressures shows a significant correlation ($p<0.001$) with weight status.

Conclusion

In conclusion, 86 percent of the study subjects belong to non overweight category and 14 percent to overweight category. Anthropometric data of the subjects by weight status shows a significant increasing trend with increasing BMI percentiles in the study population and the biochemical profile of the subjects shows that the systolic and diastolic blood pressure, serum insulin, triglycerides and fasting blood glucose were gradually escalating from non overweight to overweight subjects. On analyzing the distribution of metabolic risk on the basis of weight status, it was found that majority of the overweight subjects had increased levels of all investigated risk factors as compared to their counterparts. Serum insulin and systolic blood pressure show a significant correlation with weight status. Overall 66.7 percent of the overweight children had clustering of one or two risk factors of metabolic syndrome when compared to 46.3 percent of non overweight subjects. Thus it can be concluded that the frequency of clustering of metabolic risk factors is higher among overweight subjects increasing their risk of chronic degenerative diseases.

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