PREVALENCE OF OVERWEIGHT, OBESITY, PAEDIATRIC METABOLIC SYNDROME AND ASSOCIATED RISK FACTORS AMONG CHILDREN IN THE AGE GROUP OF 10-16 YEARS IN PRIVATE SCHOOLS OF SHIMLA CITY

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ABSTRACT

BACKGROUND

Paediatric obesity is a complex and growing global problem which is escalating much more rapidly in developing countries like India and considered an important predecessor to NCD multi-morbidity due to changing life style as a result of rapid urbanisation and mechanisation.

The aim of this study was to estimate the prevalence of overweight, obesity, paediatric metabolic syndrome and associated risk factors among children in the age group of 10-16 years in private schools of Shimla city.

MATERIALS AND METHODS

At total of 2100 adolescents attending school (aged 10-16 years) participated in this cross-sectional study. All the anthropometric, clinical and biochemical assessment was done after proper consent. Prevalence of overweight and obesity was assessed by using IOTF guidelines and the metabolic syndrome was determined by the Paediatric International Diabetic Federation definition modified for age group.

RESULTS

The prevalence of overweight, obesity and paediatric metabolic syndrome was 14.5%, 4.1% & 4.3% respectively. In the groups with PMS, hypertension, waist circumference, and TG were significantly higher, and HDL-C was significantly lower. Significant difference was observed in gender, physical activity level, metabolic equivalent, consumption of junk food & time spent on TV in the distribution of overweight, obesity and metabolic syndrome.

CONCLUSION

Our study highlights the possible role of change in the dietary pattern and physical activity pattern in the development of obesity and metabolic syndrome in early stage of life. Collective efforts of parents and schools are required to institute early preventive measures to reduce progression towards obesity and its future complications.

KEYWORDS

Overweight, Obesity and Paediatric Metabolic Syndrome.

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BACKGROUND

The global tsunami of Noncommunicable Diseases has swept across all age groups, including children and adolescents. Problems like overweight and obesity are escalating as a global epidemic, will progress in forthcoming decades, putting further stress on the healthcare system and probably leading to increased morbidity and a shorter lifespan for future generations.[1] Metabolic syndrome as described by Gerald Reaven and colleagues is a constellation of metabolic abnormalities that include abdominal obesity, glucose intolerance, hypertension, elevated triglycerides and low High Density Lipoprotein cholesterol. This has been called the 'New World Syndrome'.[2] Prevalence of Paediatric Metabolic Syndrome among children and adolescents around the world is 10%, ranging from near 2% among normal weight children and adolescents to about 32% among the obese children.[3] The prevalence of Paediatric metabolic syndrome amongst children in the age group 10-18 years is rising at an alarming rate and was found to be between 4-10% in different studies held in various parts of India.[4-7] The children in hilly areas possibly have different lifestyle, dietary and physical activity pattern as compared to non-hilly areas and there is a paucity of data in children and

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adolescents residing at mountainous regions like Shimla. Hence to fill the gap in the existing knowledge, the present study has focused to determine the magnitude of this upcoming problem and its correlation in adolescent school children between 10 and 16 years of age in public schools of Shimla city, in Himachal Pradesh, India using International Diabetes Federation criteria.

MATERIALS AND METHODS

Study Design- It was a cross-sectional school-based study.

Study Area- The study was conducted in Shimla which is the capital city of Himachal Pradesh located in the south-western ranges of the Himalayas at 31.61°N 77.10°E. It has an average altitude of 2,206 meters (7,238 ft) above mean sea level.

Study Period- One year (1st September 2015 to 31st August 2016).

Sample Size- Sample size was calculated by presuming the prevalence of metabolic syndrome to be 7% (Mean of the reported prevalence in various studies in India between 4%-10%).[4-7] The desired sample size using the formula $N = Z^2 P (1-P)/e^2$ was 1276 with normal deviate (z) =1.96 at 0.05 level of significance and the confidence interval being 95% and taking the allowable error (e) or relative precision to be 20% of the prevalence. Considering design effect as 1.5 the sample size came out to be 1913.94. Correcting for a non-compliance of approx. 10%, the target sample size was about 2105 children. Taking the round off, 2100 children were enrolled for the study.

Sampling Design- Subjects were selected by using cluster sampling technique. For this, a 'cluster' was defined as a private school of the city. All the private schools of Shimla city were enlisted. Utilising probability proportionate to size sampling methodology, 30 clusters were selected from the selected schools. From each cluster, 70 children between 10-16 years of age were selected using random number table, after obtaining written consent of guardian/parents/school authorities. In case the requisite sample was not available in the identified cluster, the nearest private school was included to complete the sample size of cluster.

Strategy for Data Collection- In the identified schools, children were briefed about the objectives of the study and written consent was taken from their parents. The information was collected using a pretested questionnaire on sociodemographic profile, physical activity pattern and dietary assessment from all the subjects.

Weight was measured while the subjects were barefoot and wearing light clothes in upright position using digital scales (SECA 813) and recorded to the nearest 0.1 kg. Height was measured in a standing position with his/her head held in Frankfort horizontal plane, barefoot, using a stadiometer (SECA 213) and recorded to the nearest 0.1 cm. Waist circumference was measured to the nearest of 0.1 cm using a non-stretchable measuring tape, in mid respiration without any pressure to body surface, at the middle point between the lower border of ribcage and iliac crest. 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 encircling 80% to 100% of the of the right arm's circumference. It was recorded to the nearest 2 mmHg.

Blood samples were obtained in the morning through an antecubital vein using vacutainer tubes containing EDTA from the subjects who had fasted for at least 8-10 hours, and transferred to the biochemistry laboratory at Indira Gandhi Medical College, Shimla within 4 hours of maintenance of proper cold chain. HDL-cholesterol and serum triglycerides were assessed by the standard enzymatic kit method using an autoanalyser. FBS was measured using a glucometer by glucose oxidase method.

Inclusion Criteria

1. Adolescents in the age group of 10-16 years enrolled in private schools of Shimla city.
2. Adolescents whose parents/guardian/school authorities consented to participate in the study.

Exclusion Criteria

1. Adolescents having physical deformity of stature.
2. Adolescents suffering from acute disease which could have changed their current dietary intake.

Diagnostic Criteria- Criteria for Assessment of Paediatric Metabolic Syndrome (PMS).

International Diabetes Federation, 2007 (IDF Criteria)

1. Abdominal obesity (WC ≥90th percentile value for age and sex).
   Waist circumference > 37 inches (90 cm) in men or
   > 31.5 inches (80 cm) in women
2. At least two or more than two of the following-
   i. Fasting blood Glucose: ≥100 mg/dL or known Type 2 DM
   ii. Triglycerides: ≥150 mg/dL
   iii. HDL-C : Men <40 mg/dL
   Women <50 mg/dL
   iv. Blood Pressure: Systolic ≥ 130 mmHg and
   Diastolic ≥85 mmHg

Criteria for Assessment of Overweight and Obesity

The International Obesity Task Force (IOTF) standard for analysing childhood overweight and obesity data has been adopted.

Overweight (OW): will be defined as children with BMI value between 85th to 95th percentile for a specific age and gender. Obesity (OB): will be defined as children with a BMI value above 95th percentile for a specific age and gender.

Statistical Methods- The collected data was thoroughly screened and entered in Microsoft Excel spreadsheet 2007. Statistical analysis was done by using Epi Info 7 software. Descriptive statistics, frequency percentages were determined for categorical variables with 95% confidence

interval. Mean & standard deviations were determined for quantitative variables. The association of various risk factors with paediatric metabolic syndrome was first assessed with univariate analysis. A p value of <0.05 was taken as significant. All those variables significant at p<0.05 in univariate analysis were then evaluated by binary logistic regression modelling for Adjusted Odds Ratio (AOR) with 95% confidence interval (CI). The variables having AOR greater than 1, with 95% CI (not including the value 1) were taken to be the risk factors. The variables, which continued to have AOR smaller than 1, with 95% CI (not including 1) were taken to be the protective factors.

Ethical Aspects- Prior permission was taken from ethical committee of Indira Gandhi Medical College, Shimla to go ahead with the study. Confidentiality of information gathered from study subjects was maintained in accordance with the principles embodied in the declaration of Helsinki and International guidelines for ethical review of epidemiological studies.

Results and Observation- There were 1128 (54%) male and 972 (46%) female participants in the study. Majority (67%) of the participants were in the age group of 14-16 years. Male to female ratio was 1.16. There were almost equal number of participants from primary to middle and high to senior secondary level. Majority (68%) of participants belonged to nuclear family. 56% of the participants were from socioeconomic class I. Maximum numbers of participants were of Hindu religion. This was followed by Buddhists, Sikhs, Christians and Muslims respectively. Almost three-fifth (61%) of the study participants were vegetarian. (Table 1).

Sociodemographic Variables	Category	Male n (%)	Female n (%)	Total n (%)
Age Groups	10-13 years	371 (17.7%)	317 (15.1%)	688 (32.8%)
	14-16 years	757 (36.0%)	655 (31.2%)	1412 (67.2%)
Education	Class 5th -8th	588 (28%)	467 (22.2%)	1055 (50.2%)
	Class 9th- 12th	540 (25.7%)	505 (24%)	1045 (49.8%)
Type of family	Nuclear family	752 (35.8%)	680 (32.4%)	1432 (68.2%)
	Joint family	376 (17.9%)	292 (13.9%)	668 (31.8%)
Socioeconomic Class*	SEC I	619 (29.5%)	558 (26.6%)	1177 (56.0%)
	SEC II	505 (24.0%)	413 (19.7%)	918 (43.7%)
	SEC III	4 (0.2%)	1 (0.0%)	5 (0.2%)
Religion	Hindu	1032 (49.1%)	877 (41.8%)	1909 (90.9%)
	Muslim	4 (0.2%)	1 (0.0%)	5 (0.2%)
	Sikh	27 (1.3%)	1 90.9%	46 (2.2%)
	Christian	4 (0.2%)	8 (0.4%)	12 (0.6%)
	Others (Buddhist)	61 (2.9%)	67 (3.2%)	128 (6.1%)
Type of Diet	Vegetarian	641 (30.5%)	647 (30.8%)	1288 (61.3%)
	Non-vegetarian	487 (23.2%)	325 (15.5%)	812 (38.7%)
	Total	1128 (53.7%)	972 (46.3%)	2100 (100.0%)

Table 1. Distribution of Study Participants According to Sociodemographic Characteristics

*According to "Modified Kuppuswamy Scale".

A total of 304 subjects (14.5%) out of 2100 were found to be overweight and 87 (4.1%) were having obesity as per criteria laid down by IOTF. 4.3% of the participants were found to be having PMS as per IDF Criteria. (Figure 1).

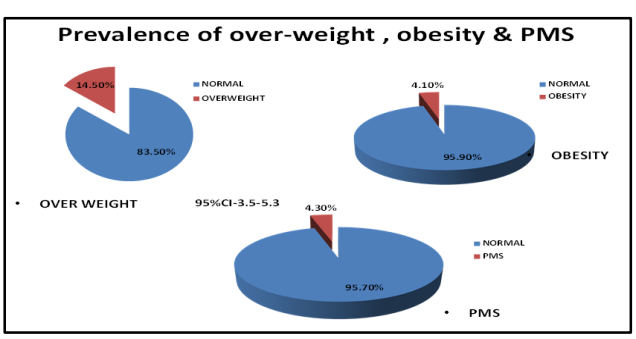

Figure 1. Prevalence of Overweight, Obesity & PMS

Among overweight participants, 13% were found to have PMS. Among the obese participants the prevalence of PMS was found to be as high as 57%. (Figure 2).

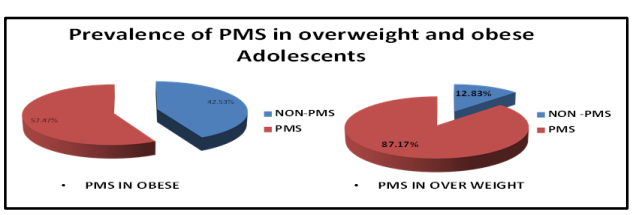

Figure 2. Prevalence of PMS among Overweight and Obese Study Participants

A total of 993 participants (47%) were not having any component of PMS. 44% of the participants were having 1 to 2 components of PMS. Almost 8% of the study participants were having 3 or more components of PMS. Only one participant had all the components of PMS. (Table 2).

Number of PMS components	Male (1128) n (%)	Female (972) n (%)	Total (2100) n (%)	Chi Square (df)	P value
0	559 (49.56)	439 (44.65)	993 (47.29)	27.55 (6)	<0.001
1	328 (29.08)	359 (36.93)	687 (32.71)		
2	123 (10.90)	122 (12.55)	245 (11.67)		
3	74 (6.56)	37 (3.81)	111 (5.29)		
4	34 (3.01)	15 (1.54)	49 (2.33)		
5	9 (0.80)	5 (0.51)	14 (0.67)		
6	1 (0.09)	0 (0%)	1 (0.05)		

Table 2. Frequency of Components of PMS in the Study Participants

All the baseline variables for risk factors were found significantly high among participants having PMS. (Table 3).

Sl. No.	Risk Factor	PMS N=90	Non-PMS N=2010	Total N=2100	P* value
1.	WC > for gender >80 cm For girls >90 cm for boys	90 (100%)	72 (3.58%)	162 (7.71%)	<0.001
2.	SBP ≥ 130 mmHg	49 (54.44%)	254 (12.64%)	303 (14.43%)	<0.001
3.	DBP ≥ 85 mmHg	47 (52.22%)	178 (8.86%)	225 (10.71%)	<0.001
4.	FBS ≥ 100 mg/dL	29 (32.32%)	243 (12.09%)	272 (12.95%)	<0.001
5.	TG ≥ 150 mg/dL	54 (60.0%)	149 (7.41%)	204 (9.71%)	<0.001
6.	HDL > for gender <40 mg/dL for boys <50 mg/dL for girls	66 (73.33%)	551 (27.41%)	617 (29.38%)	<0.001

Table 3. Distribution of Various Clinical, Anthropometric and Biochemical Risk Factors Among PMS and Non-PMS Participants

The Odds of having paediatric metabolic syndrome were higher among Males & affluent Socioeconomic class I. Odds were low in age group of 10-13 years, primary to middle educational level and in nuclear families. Socioeconomic class I was found to be positively associated and statistically significant with PMS. (Risk factor). Primary to middle educational level was found to be negatively associated and statistically significant with PMS. (Protective factor) (Table 4).

Risk Factors	Category	PMS n (%)	Non-PMS n (%)	Total (n)	Chi Square	Odds Ratio (95% CI)	P Value*
Gender	M	53 (4.70)	1075 (95.30)	1128	1.01	1.25 (0.81-1.91)	0.31
	F	37 (3.81)	935 (96.19)	972			
Age group	10-13	23 (3.34)	665 (96.66)	688	2.22	0.69 (0.42-1.13)	0.13
	14-16	67 (4.75)	1345 (95.25)	1412			
Class	5^{th} -8^{th}	30 (2.84)	1025 (97.16)	1055	10.749	0.48 (0.31-.75)	0.001
	9^{th}- 12^{th}	60 (5.74)	985 (94.26)	1045			
Type of family	Nuclear	60 (4.19)	1372 (95.81)	1432	0.10	0.93 (0.59-1.45)	0.75
	Joint	30 (4.49)	638 (95.51)	668			
SEC	SEC I	63 (5.33)	1120 (94.67)	1183	7.14	1.85 (1.17-2.94)	0.01
	≤ SEC II	27 (2.94)	890 (97.06)	917			

Table 4. Association of the Sociodemographic Risk Factors with the Paediatric Metabolic Syndrome on Univariate Analysis

*****P value <0.05 was taken as significant.

Odds of having PMS were higher among vegetarian, who ate snacks in canteen during lunch break and who slept for less than 8 hours per day. Odds were low in participants who went to school on foot, brought lunch in school, having screen hours less than 2 hours per day and those who ate junk food less than 4 times a week. Eating snacks in canteen, junk food more than 4 per week & sleeping hours less than 8 hours was found to be positively associated and statistically significant with PMS (Risk factor). Odds of having paediatric metabolic syndrome were increased as level of physical activity decreases and energy expenditure decreases, so both these values were found to be positively associated and statistically significant with PMS. (Risk Factors).

Risk Factors	Category	PMS n (%)	Non-PMS n (%)	Total (n)	Chi Square	Odds Ratio (95% CI)	P Value*
Mode of transport to school	On Foot	48 (4.21)	1092 (95.79)	1140	0.03	0.96 (0.62-1.46)	0.949
	By Vehicle*	42 (4.38)	918 (95.63)	960			
Type of diet	Vegetarian	59 (4.58)	1229 (95.42)	1288	0.71	1.21 (0.78-1.88)	0.55
	Non-Vegetarian	31 (3.82)	781 (96.18)	812			
Brought lunch to school	Yes	84 (4.23)	1900 (95.77)	1984	0.23	0.81 (0.34-1.89)	0.86
	No	6 (5.17)	110 (94.13)	116			
Ate snacks in canteen	Yes	67 (6.36)	987 (93.64)	1054	22.12	3.01 (1.8-4.8)	0.00
	No	23 (2.20)	1023 (97.80)	1046			
Screen hours/ day	< 2 hours	23 (3.43)	648 (96.57)	671	1.77	0.72 (0.44-1.160	0.18
	≥2 hours	67 (4.69)	1362 (95.31)	1429			
Junk food/week	< 4 times	6 (1.14)	521 (98.86)	527	1698	0.20 (0.08-0.47)	0.00
	≥4 times	84 (5.34)	1489 (94.66)	1573			
Sleep hours in a day	< 8 hours	43 (6.36)	633 (93.64)	676	10.46	1.99 (1.33-3.04)	0.00
	≥8 hours	47 (3.30)	137 (96.70)	1424			
Physical activity level	≤1.4	59 (6.03)	919 (93.97)	978	13.02(3)	3.13	
	1.4- 1.54	18 (3.24)	538 (96.76)	556		1.94	
	1.55-1.60	6 (3.95	146 (96.05)	152		2.39	<0.001
	≥1.61	7 (1.69)	407 (98.31)	414		1	
Metabolic Equivalent /day	≤ 1800	43 (8.22)	480 (91.78)	573	15.97 (2)	2.58	<0.001
	1801-2199	37 (2.89)	1242 (97.11)	1279		0.86	
	≥2200	10 (3.36)	288 (96.64)	298		1	

Table 5. Association of the Risk Factors with the PMS on Univariate Analysis

*****P value < 0.05 was taken as significant.

Only those risk factors with a p value of <0.05 on univariate analysis were considered for multiple logistic regression. Affluent socioeconomic class I, snacking in canteen during lunch, PAL value less than 1.4, MET Value less than 1800, sleeping less than 8 hours per day was positively associated with PMS and found to be statistically significant (Risk factors). Primary to middle educational level, junk food consumption less than 4 times per week were negatively associated with PMS and found to be statistically significant. (Protective factors).

	B	S.E.	Wald	df	P value	Exp (B)	95% C.I. for EXP(B)	
							Lower	Upper
Class 5^{th}-8^{th}	-0.733	0.228	10.333	1	0.001	0.480	0.307	0.751
Socioeconomic class I	0.538	0.240	5.044	1	0.025	1.713	1.071	2.739
PAL Value ≤1.4	1.427	0.410	12.135	1	<0.001	4.166	1.866	9.297
MET Value ≤ 1800	1.111	0.365	9.269	1	0.002	3.037	1.486	6.210
Sleep < 8 hours/day	0.740	0.223	10.993	1	0.001	2.097	1.354	3.249
Snacks in canteen in lunch break	1.283	0.252	25.920	1	<0.001	3.607	2.201	5.911
Junk food< 4 times/week	-1.589	0.426	13.936	1	<0.001	0.204	0.089	0.470

Table 6. Association of the Risk Factors with the Paediatric Metabolic Syndrome on Multiple Logistic Regressions

DISCUSSION

A total of 2100 children participated in the present study. Among the total study participants, 67% were in the pubertal age group of 13-16 years and rest 33% were in the age group of 10-13 years. Mean age of the study participants was 13.5 ± 1.8 years. The 54% of the study participants were male and rest 46% were female, reflecting the gender distribution of the city as per the census 2011 as males contributing the 54.93% of the total population of Shimla city.[8] The majority of the students (90.9%) belonged to Hindu community followed by other religions like Buddhists, Sikhs, Christians and Muslims. This finding confirmed the population distribution of the city on the basis of religion as 93.50% population of the city belongs to Hindu religion.[8] Among the total study participants, 68.2% belong to nuclear family, 99.7% were from either Socioeconomic class I or II and 61.3% were vegetarian.

This study revealed that the prevalence of overweight and obesity in adolescents was high as 14.5% and 4.10% of the study participants were overweight and obese respectively as per the IOTF criteria. Comparatively, the prevalence of overweight and obesity among the adolescents in this study is much similar to the other studies as Rohilla et al[9], Anuradha RK et al[10], Kotian et al[11], Goyal RK et al[12] which found the prevalence of overweight between 10% to 15% and that of obesity between 3%-5% in

different parts of India. However, a population-based, cross-sectional study from urban schools of Shimla city by Mahajan et al[13] in 2006, had shown the prevalence of overweight and obesity in children to be 3.0% and 0.95% respectively which was much lower than our study. This was due the fact that study was conducted a decade earlier and study population included subjects from both government and private schools.

In this study, 4.3% of adolescents in the age group of 10-16 years met the IDF criteria for the PMS. Similar prevalence of PMS was found in the hilly areas of J&K by Andrabi et al[14] and Bhatt et al[15] which found the PMS prevalence of 3.8% and 3.5% respectively. The study results were also comparable to other studies in North India by Marwaha et al,[7] Singh R et al[16] and Tandon et al[7] which showed the prevalence between 4% - 4.5%. However, higher prevalence of PMS was found in studies conducted by Kapil U et al[5] and Bhalavi et al[6] which showed the PMS prevalence of 6.5% and 9.9% respectively. Studies done by Singh N et al[17] showed the lower PMS prevalence of 2.6%.

According to the IDF criteria, prevalence of PMS in the present study was 12.8% in overweight and 57.5% in obese adolescents. Our findings were consistent with the study done by Rodrgues LG et al[18] which showed the PMS prevalence of 55.6% among obese subjects. However, lower prevalence of PMS was reported in study done by Singh N et al[17] which observed it to be between 18-25%. This may be due to the usage of small sample size in these studies.

Low HDL-cholesterol level was found to be the most prevalent risk factor among the all risk factors studied among adolescents and this finding was consistent with the previous studies by Bhalavi et al,[6] Singh N et al.[17] But this was contrary to the other studies, Rodrigues et al,[18] Bhatt et al,[15] Tandon et al[7] which showed high Triglyceride (TG) to be the most frequent risk factor.

Maximum prevalence of PMS was seen during the pubertal period between 13-16 years compared to the other age group of 10-12 years. Although the difference was not statistically significant (3.34 vs. 4.75 p=0.13). Marginally higher PMS in the pubertal age groups of 13 to 16 years may be due to physiological changes of hormonal variations resulting in adipose tissue deposition and overall weight gain during the pubertal growth spurt.

The prevalence of the PMS in adolescents may vary according to gender, as it does in adults. The prevalence of PMS was found to be higher in males than in females. However, this difference was not statistically significant (boys 4.7% and girls 3.8% p=0.31). This finding is consistent with other studies like Singh R et al[16] in Chandigarh and Bhatt et al[15] in Srinagar suggesting no significant difference in prevalence of metabolic syndrome with gender. However, contrary to this observation, studies by Kapil U et al,[5] Andrabi et al,[14] Singh N et al[17] showed that the PMS was significantly more prevalent in males than in females. Few studies by Marwaha RK, Tandon et al[7] have found the prevalence of PMS to be significantly higher in females.

According to modified Kuppuswamy scale, the prevalence of PMS was found to be significantly higher in the affluent class (Socioeconomic Class I). (Chi-square value 7.14; & p<.01). Studies by Singh R et al,[16] Rohilla R et al,[9] Anuradha RK et al,[10] Kotian et al,[11] Goyal RK et al[12] had similar observations of higher prevalence of PMS with affluent social class. The observed higher prevalence rates of PMS children in affluent class may be because of obesogenic environment in the form of sedentary lifestyles, faulty eating patterns and increased intake of junk food.

In our study, higher prevalence of PMS (4.58%) was found in participants who were vegetarian but there was no significant difference in the prevalence of PMS between vegetarian and non-vegetarian. (p=0.55). Similarly, Rohilla et al[9] had suggested that vegetarian diets did not decrease the risk of PMS compared with non-vegetarian diets. On the contrary, Rizzo et al[19] reported PMS more frequently among omnivores than vegetarians.

High prevalence of PMS was found in the adolescents who didn't bring their lunch to the school (5.17%) as compared to students who brought their lunch (4.23%) although the results were not statistically significant (p=0.95). This study also revealed that those students who ate snacks in the school canteen during the lunch break had significantly high PMS prevalence (chi-square value 22.12; & p<.001). Similar results were found in the study done by Kapil U et al[5] in Delhi.

It was also observed that the children who ate junk food more than 4 times a week had significantly higher PMS prevalence (5.34%) as compared to those who ate less than 4 times a week (1.14%). (Chi-square value 16.98; & p<.001). This was in accordance with the study of Goyal RK et al,[12] Kapil U et al[5] who also concluded that junk food habits and frequency of restaurant visits per week have positive relation with prevalence of obesity and overweight.

In this study, prevalence of PMS was found to be significantly higher in adolescents having a decreased physical activity level. (Chi-square value 15.60; & p<.00). Previous studies done by Rohilla R et al[9] in Rohtak, Kotian et al[11] in Mangalore, Goyal RK et al[12] in Ahmedabad have also shown similar type of results. This might be due the fact that decreased physical activity promotes sedentary lifestyle behaviours thereby increasing the chance of overweight, obesity and PMS among adolescents.

The prevalence of PMS among subjects using vehicle like bus/car /taxi as mode of transport was found to be higher (4.38%) compared to subjects who used to go on foot (4.21%); however, the results were not statistically significant (p=0.95). Rohila et al also revealed in their study that the bus as a mode of transport is a strong predictor of overweight and obesity (OR-4.27, 95% CI = 2.815–6.501, P <0.01). Goyal RK et al[12] observed that going to school by bus/auto was associated with 2.14 times risk of developing PMS.

High prevalence of PMS was found in the adolescents who spent more than 2 hours on screen such as watching television or using computer/mobile phones (4.69%) as compared to students who used to watch less than 2 hours

(3.43%). The results were, however, not statistically significant (p=0.18). Kotian et al[11] also observed that adolescents who spend more than 2 hours in front of a screen in a day were more likely at the risk of having PMS. Increased time spent on screen promotes sedentary lifestyle behaviours thereby increasing the chance of PMS among adolescents.

This study contributes to the body of evidence that adolescents who sleep less than 8 hours had higher risk for developing metabolic syndrome, as a statistically significant association (chi-square value 10.46; & p<0.01) was observed between sleep less than 8 hours per day and PMS. Similar observations were reported by various cross-sectional studies from around the globe like Anuradha RK et al,[10] Goyal RK et al[12] which show a consistent increased risk of obesity and PMS amongst short sleepers in children and adults. Sung V et al[20] in their study also observed that subjects who slept ≤5 hours per night demonstrated the highest risk for the metabolic syndrome (OR 1.74, 95% CI 1.33–2.26, P<0.001). Subjects who slept ≥9 hours per night exhibited increased risk for the metabolic syndrome even after adjustment of other risk variables (OR 1.69, 95% CI 1.17–2.45, P=0.006).

CONCLUSION

This study highlights the alarming trends in the prevalence of overweight, obesity and metabolic syndrome among adolescents in the private schools of Shimla city. Thus, there is an urgent need for adoption of healthy lifestyles among adolescents in order to halt development of these metabolic disorders further.

RECOMMENDATION

A multidisciplinary approach involving parents, teachers, department of health, education, district health agencies, Municipal Corporation, NGOs and various other stakeholders is needed to address this problem. Health education sessions during the parents teacher meeting (PTM) held in schools should cover adopting healthy eating behaviour. Mothers should be counselled to prepare and pack healthy lunch for school every day. They should also be encouraged to make nutritious food items for their kids at home with emphasis on maintaining variety to break the monotony. Students as well as parents should be advised to avoid eating or at least lowering the frequency of junk food consumption both at home as well in schools. District administration authorities as well as schools should be suggested for banning of the junk food at school premises. Parents should be encouraged that their children should spend less than one hour per day on screen like TV/Computers/ mobile phones with emphasis on outdoor activities for at least 30 minutes per day. Children should be advised to have a sound sleep of 8-10 hours per day. It is recommended that a similar study should also be conducted in the government schools of the city to estimate the burden of overweight, obesity and PMS among these adolescents.

Limitation of the study

This was a Private school-based study. The adolescents in the private schools may not be a representation of all adolescents in the community. It is difficult to say whether this might have led to an underestimate or an overestimate of the prevalence of PMS.

REFERENCES

[1] De Ferranti SD, Osganian SK. Epidemiology of paediatric metabolic syndrome and type 2 diabetes mellitus. Diab Vasc Dis Res 2007;4(4):285-296.
[2] Gracey M. New world syndrome in western Australian aborigines. Clin Exp Pharmacol Physiol 1995;22(3):220-225.
[3] Bahl D, Singh K, Sabharwal M, et al. Anthropometric indices for the prediction of metabolic syndrome and its features, among children and adolescents. Indian Journal of Science and Technology 2014;7(8):1066–1107.
[4] World Health Organization. Global infobase : data on overweight and obesity. 2015. Http://Www.Who.Int/Mediacentre/Factsheets/Fs311/En/ Accessed 26 September 2016.
[5] Kapil U, Kaur S. Prevalence of pediatrics metabolic syndrome amongst children in the age group of 6-18 years belonging to high income group residing in national capital territory (Nct) of Delhi. Indian J Pediatr 2010;77(9):1041.
[6] Bhalavi V, Deshmukh P, Atram M, et al. Prevalence of metabolic syndrome and cardio-metabolic risk factors in the adolescents of rural Wardha. International Journal of Biomedical Research 2014;5(12):754-757.
[7] Marwaha RK, Tandon N, Garg MK. Prevalence of metabolic syndrome among urban Indian adolescents and its relation with insulin resistance. J Pediatr Endocr Met 2013;26(11-12):1123-1130.
[8] Census 2011. Himachal Pradesh. http://www.census2011.co.in/data/town/800137-shimla-himachal-pradesh.html.
[9] Rohilla R, Rajput M, Rohilla J, et al. Prevalence and correlates of overweight/obesity among adolescents in an urban city of north India. J Fam Med Primary Care 2014;3(4):404-408.
[10] Anuradha RK, Sathyavathi RB, Reddy TM, et al. Effect of social and environmental determinants on overweight and obesity prevalence among adolescent school children. Indian J Endocr Metab 2015;19(2):283-287.
[11] Kotian MS, S GK, Kotian SS. Prevalence and determinants of overweight and obesity among adolescent school children of south Karnataka, India. Indian J Community Med 2010;35(1):176-178.
[12] Goyal RK, Shah VN, Saboo BD, et al. Prevalence of overweight and obesity in Indian adolescent school going children: its relationship with socioeconomic status and associated lifestyle factors. J Assoc Physicians India 2010;58:151-158.

[13] Mahajan A, Negi PC. Prevalence of overweight and obesity in urban school going adolescents in Shimla city. Int J Nutr Pharmacol Neurol Dis 2014;4(5):23-28.
[14] Andrabi MS, Bhat MH, Andrabi SR, et al. Prevalence of metabolic syndrome in 8-18-year-old school-going children of Srinagar city of Kashmir India. Indian J Endocrinol Metab 2013;17(1):95-100.
[15] Bhat RA, Parray I, Ahmad Z. Prevalence of the metabolic syndrome among north Indian adolescents using adult treatment panel III and pediatric international diabetic federation definitions. J Diabetes Metab 2014;5(3):352-356.
[16] Singh R, Bhansali A, Sialy R, et al. Prevalence of metabolic syndrome in adolescents from a north Indian population. Diabetic Medicine 2007;24(2):195-199.
[17] Singh N, Parihar RK, Saini G. Prevalence of metabolic syndrome in adolescents aged 10-18 years in Jammu. J and K. Indian J Endocrinol Metab 2013;17(1):133-137.
[18] Rodrigues LG, Mattos AP, Koifman S. Prevalence of metabolic syndrome in overweight and obese outpatient children and adolescents: comparative analysis using different clinical definitions. Rev Paul Pediatr 2011;29(2):178-185.
[19] Rizzo NS, Sabate J, Jaceldo-Siegl K, et al. Vegetarian dietary patterns are associated with a lower risk of metabolic syndrome: the Adventist health study 2. Diabetes Care 2011;34(5):1225–1227.
[20] Sung V, Beebe DW, Vandyke R, et al. Does sleep duration predict metabolic risk in obese adolescents attending tertiary services? A cross-sectional study. Sleep 2011;34(7):891-898.