

# Does Dietary Pattern Affect BMI of Adolescents? A Comparative Study between the Affluent Government and Private Schools of Madurai District, Tamil Nadu, India

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**Abstract— Objective:** The purpose of this study was to identify the important factors (linked to genetics, dietary pattern) related to overweight/obesity among school-going adolescents in Madurai District, Tamil Nadu.

**Methods:** Close ended questionnaire was framed to elicit the information from the school-going adolescents. Data were collected on the socio-demographic information and frequency of consumption of certain non-vegetarian foods, family history on obese.

**Results:** Among 7660 subjects, 514 samples were found to be overweight and obese and analyzed with the appropriate statistical tools such as percentage analysis, chi-square test to check the level of significance. 74.4 percent of the obese category implies that the respondents take to have the habit of taking snacks. The prevalence of Overweight 95 (18.48%) and obese 315 (61.28%) was found to be higher in Nuclear families, but there was no statistical association between family type and BMI ( $X^2 = 2.575, p > .05$ ). A significant relationship was found between the Body Mass Index of the adolescents and Father's Educational qualification ( $p=.00$ ) and Mother's Occupation ( $p=.008$ ). No Association was found between the BMI and family members obese of the school-going adolescents. With respect to obese girls father's were 10.7% belonged to obese than other members of family. This statement is applicable for obese boys also (6.4%). With respect to girls father's were more obese (22.4 %) than another family member's in the study population. This statement is applicable for obese boys also (13.4%). There is no association of BMI with both gender (Over weight) was statistically not significant ( $p<0.879$ ). On the hand there is an association of BMI with both gender (Obesity) was statistically 5 % level of significant ( $p<0.120$ ).

**Conclusions:** Improving adolescents knowledge to take balanced nutrition; to eat more fruits and vegetables rather than non-vegetarian regularly; to stop eating before fullness and to do regular physical exercise may promote healthy body weight management among students and reduce the prevalence of overweight and obesity.

**Keywords—** Eating and snacking habits, Physical activity, Overweight, Obesity and Adolescents

## I. INTRODUCTION

Since 1980 obesity has doubled worldwide. In 2014 more than 1.9 billion adults (18 years and older) and 41 million children under the age of five were overweight. Nearly half of the children under five who were overweight or obese in 2014 lived in Asia. Today, half a billion people which is 12 per cent of the world's population are obese [1]. The epidemic of obesity among youth is spreading at an alarming rate. The percentage of youths who are at risk of becoming overweight continues to increase [2]. National data indicates that 16 per cent of children aged six to nineteen years are overweight. Once it was thought as a problem of high- income countries now the problem of overweight and obesity are increasing in low income and

middle-income countries especially in urban areas.

Body mass index (BMI) is usually recommended for identifying overweight or obese children and youth[3]. It is a measure of excess weight relative to height rather than excess body fat and may be a less sensitive indicator of fatness among children [4]. Dietary habits during childhood are associated with increased adiposity adolescence with specify implications for dietary energy density, fat and fiber intake. Improving diet quality may reduce the risk of obesity in young people [5]. However, the contribution of these trends to obesity in child and adolescent populations is not yet well understood. In particular, there is a lack of consensus in regard to the impact of snacking patterns on weight status to inform the development of recommendations and interventions.

This study aimed to: 1) examine dietary habits, and 2)

evaluate the association between BMI with obesity inherently followed.

## II. MATERIALS AND METHODS:

### Research design

This cross-sectional study was conducted in Government and Private Schools of Madurai District, Tamil Nadu. It adopted a cross-sectional descriptive study design which included questionnaire development, quantitative data collection and analysis. Descriptive research determines and reports the way things are and also helps a researcher to describe a phenomenon in terms of attitude, values and characteristics [6]. According to, descriptive case study is a method of collecting information by interviewing or administering a questionnaire to a sample of individuals [7].

### Target Population

Target population for this study consisted of adolescent students aged 13-18 years from the Government and private schools of Madurai District, Tamil Nadu. Both male and female regardless of their religious backgrounds and area of residence were targeted for the study. According to the Head of departments within the schools, the schools had a total of 7660 continuing students. 5339 school children were from Government and Government aided schools and 2321 school children from private schools. 6.71 % (514) of children fall under the overweight and obesity category, whereas the rest of them falls either in normal or underweight category. Out of 5339, 63 children were overweight and 233 were obese in Government and Government aided Schools whereas 64 were overweight and 154 were obese out of 2321 children from private schools. These 514 school going children were considered as respondents to elicit further information.

Eligible participants were scheduled for an individual baseline data collection visit at which the study was reviewed, eligibility confirmed, and informed consent was obtained. Eligibility criteria included the following: 1) age 13–18 years; 2) non-smokers; 3) fluent in either English or Local Language-Tamil; 4) not taking medications that affect appetite or body weight; 5) not currently on a diet to lose weight; 6) no history of a diagnosed eating disorder; 7) not moving from the area during the next six months; 8) not currently taking part in another research study.

### Sample size

Sample size refers to the number of units or people that are chosen from which the researcher wish to gather information or data [14]. The sample size was calculated using the formula  $n = N * X / (X + N - 1)$ , where,  $X = Z_{\alpha/2} * p * (1-p) / MOE^2$ .  $Z_{\alpha/2}$  is the critical value of the Normal

distribution at  $\alpha/2$  (e.g. for a confidence level of 95%,  $\alpha$  is 0.05 and the critical value is 1.96), MOE is the margin of error,  $p$  is the sample proportion, and  $N$  is the population size. Note that a Finite Population Correction has been applied to the sample size formula [15]. With Margin of Error: 1.47%, Confidence Level: 99%, Sample Proportion: 50%, the Sample Size for the above mentioned population is **7657**. For better convenience, the sample size is culminated to **7660**.

### Sampling technique

The stratified random sampling technique was used to obtain the samples. The choice of this technique was based on the fact that it is more convenient when the population is very large and that it provides greater precision. The technique involved dividing the entire students of Government and Private school population into strata: underweight, Normal, Overweight and Obese and then applying random sampling methods on each stratum to obtain the final study sample size (514).

### Administration of data collection instruments

The questionnaires were distributed to the children at the beginning of morning classes when they were not tired and their level of concentration was high. The researcher verbally explained the purpose of the study, in order to influence them to take the questionnaires seriously. Administering the questionnaire to the children, when they are gathered together helps in maximizing the response rate [8].

**Height:** A stadiometer was used to measure the height of the children. The children were made to stand erect without shoes on a flat floor by the scale with heels together and toes apart. The head was comfortably held erect and the arms were relaxed and held in a natural manner. The head piece of the stadiometer was lowered slowly and was placed in the sagittal plane over the head of the child applying a slight pressure to reduce the thickness of hair and make contact with the top of the head. Using this technique, the height of the children was measured to the nearest 0.1 cm accuracy [10].

**Weight:** Body weight is the most widely used and the simplest reproducible anthropometric measurement for the evaluation of nutritional status of young children. Body weight of all the children was measured using a digital weighing balance. The balance was validated using known weight for every 5 readings. The children were made to stand erect with minimum clothing and barefoot. The weight was noted to the nearest 0.1 kg [10].

**BMI Percentiles:** BMI, age and sex, specific percentile values for children both boys and girls were used to find out

Underweight, Normal, Overweight, and Obese. In clinical practice, BMI for age growth charts can be used to determine an adolescent's BMI for age percentile and to track relative weight status through childhood to adolescence.

Percentile	BMI Category*
<5th Percentile	Underweight
≥5th to <85th Percentile	Normal
≥85th Percentile to <95th Percentile	Overweight/At risk
≥95th Percentile	Obesity

\*CDC, 2000 [23]

BMI percentiles were calculated using the online calculator for grouping the selected pre- adolescents according to the BMI category.

### III. DATA ANALYSIS PROCEDURE

Collected data was organized and analysed as quantitative. All the data were cleaned, coded and entered in the Statistical Package for Social Sciences (SPSS) for analysis using descriptive statistics to generate frequency tables. Inferential statistics, specifically correlation analysis were carried out to determine the direction and strength of association that could exist between eating habits and the BMI of the study participants [9]. Chi-square was used to determine if there is any relationship between eating habits and the BMI of the study participants. Pearson Chi-Square  $p < 0.05$  indicated that the relationship was statistically significant while  $p > 0.05$  indicated that the relationship was not statistically significant. Results of the analysis were presented in pie charts, bar graphs and tables.

### IV. RESULTS AND DISCUSSION

**Table1: Socio-demographic characteristics of the students and their comparison with Body Mass Index**

Variables	Body Mass Index			p-value
	Overweight (%)	Obesity (%)	Total (%)	
Religion				$\chi^2 = 2.779$ df=2 $p = .24$
<b>Hindu</b>	<b>107 (20.81%)</b>	<b>343 (66.73%)</b>	<b>450 (87.54%)</b>	
<b>Christian</b>	<b>4 (0.77%)</b>	<b>14 (2.72%)</b>	<b>18 (3.49%)</b>	
<b>Muslim</b>	<b>16 (3.11%)</b>	<b>30 (5.86%)</b>	<b>46 (8.97%)</b>	
Family Type				$\chi^2 = 2.575$ df=1 $p = .10$
<b>Nuclear</b>	<b>95 (18.48%)</b>	<b>315 (61.28%)</b>	<b>410 (79.78%)</b>	
<b>Joint</b>	<b>32 (6.22%)</b>	<b>72 (14 %)</b>	<b>104 (20.22%)</b>	
Father's Education				$\chi^2 = 16.423$ df=4 $p = .002^{\#}$
<b>Illiterate</b>	<b>15 (2.91%)</b>	<b>77 (14.98%)</b>	<b>92 (17.89%)</b>	
<b>Primary School</b>	<b>14 (2.72%)</b>	<b>82 (15.95%)</b>	<b>96 (18.67%)</b>	
<b>High School</b>	<b>22 (4.28%)</b>	<b>62 (12.06%)</b>	<b>84 (16.34%)</b>	
<b>Post High School Diploma</b>	<b>55 (10.7%)</b>	<b>107 (20.8%)</b>	<b>162 (31.51%)</b>	
<b>Graduate (or) Post Graduate</b>	<b>21 (4.08%)</b>	<b>59 (11.47%)</b>	<b>80 (15.56%)</b>	
<b>Professional Degree</b>	-	-	-	$\chi^2 = 9.165$ df=4 $p = .057$
Mother's Education				
<b>Illiterate</b>	<b>18 (3.5%)</b>	<b>78 (15.17%)</b>	<b>96 (18.67%)</b>	
<b>Primary School</b>	<b>14 (2.72 %)</b>	<b>57 (11.08%)</b>	<b>71 (13.81%)</b>	
<b>High School</b>	<b>19 (3.69%)</b>	<b>79 (15.36%)</b>	<b>98 (19.06%)</b>	
<b>Post High School Diploma</b>	<b>55 (10.7%)</b>	<b>119 (23.15%)</b>	<b>174 (33.85%)</b>	
<b>Graduate (or) Post Graduate</b>	<b>21 (4.08%)</b>	<b>54 (10.5%)</b>	<b>75 (14.59%)</b>	
<b>Professional Degree</b>	-	-	-	$\chi^2 = 3.351$ df=5 $p = .64$
Father's Occupation				
<b>Unskilled Worker</b>	<b>69 (13.42%)</b>	<b>226 (43.96%)</b>	<b>295 (57.39%)</b>	
<b>Semi-Skilled Worker</b>	<b>33 (6.42%)</b>	<b>87 (16.92%)</b>	<b>120 (23.34%)</b>	
<b>Skilled Worker</b>	<b>12 (2.33%)</b>	<b>28 (5.44%)</b>	<b>40 (7.78%)</b>	
<b>Clerical, Shop Owner</b>	-	<b>4 (0.77%)</b>	<b>4 (0.77%)</b>	
<b>Semi-Professional</b>	<b>12 (2.33%)</b>	<b>35 (6.80%)</b>	<b>47 (9.14%)</b>	
<b>Professional (White Collar)</b>	<b>1 (0.19%)</b>	<b>7 (1.36%)</b>	<b>8 (1.55%)</b>	
Mother's Occupation				
<b>House Wife</b>	<b>83 (16.14%)</b>	<b>305 (59.33%)</b>	<b>388 (75.48%)</b>	
<b>Semi-Skilled Worker</b>	<b>18 (3.5%)</b>	<b>24 (4.66%)</b>	<b>42 (8.17%)</b>	

Skilled Worker	6 (1.16%)	14 (2.72%)	20 (3.89%)	$\chi^2 = 13.743$ df=4 p = .008 <sup>#</sup>
Clerical, Shop Owner	-	4 (0.77%)	4 (0.77%)	
Semi-Professional	20 (3.89%)	40 (7.78%)	60 (11.67%)	
Professional (White Collar)	-	-	-	
Family Income				$\chi^2 = 2.649$ df=4 p = .618
<Rs.7887-13,160	70 (13.61%)	230 (44.74%)	300 (58.36%)	
Rs.13,161-19,758	33 (6.42%)	88 (17.12%)	121 (23.54%)	
Rs.19,759-26,354	12 (2.33%)	28 (5.44%)	40 (7.78%)	
Rs.26,355-52,733	-	4 (0.77%)	4 (0.77%)	
>Rs.52,734	12 (2.33%)	37 (7.19%)	49 (9.53%)	

Table 1 represents the Socio demographic Information of the school going students and their Body mass Index. Among all religions, obesity (66.73%) and overweight (20.81%) were found to be more among Hindus. The proportion of students who reported being overweight and obese did not differ by religion ( $X^2 = 2.779, p > .05$ ). Overweight 95 (18.48%) and obese 315 (61.28%) students were seen more in Nuclear families, but there was no statistical association between family type and BMI ( $X^2 = 2.575, p > .05$ ). The rate of overweight

(10.7%) and obesity (20.8%) was higher in students whose father had post high school Diploma level of education. There is no significant relationship between Fathers' educational qualification and Body mass Index of the children ( $p=0.00$ ). In Contrast, prevalence of overweight (10.7%) and Obesity (23.15%) was found in students whose mother had high school Diploma level of education and it is not statistically significant with Body mass Index of the children ( $p=.057$ ).

Table 2: Age and Gender wise distribution of study population in different schools

Adolescent Stage	Government Schools			Private Schools			Grand Total
	Boys (%)	Girls (%)	Total (%)	Boys (%)	Girls (%)	Total (%)	
Early (13-14yrs)	58 (13.13)	60 (11.35)	118 (24.48)	96 (18.46)	66 (12.69)	162 (31.15)	286 (55.63)
Middle (15-16yrs)	18 (3.26)	42 (8.09)	60 (11.35)	14 (2.69)	22 (4.23)	36 (6.92)	96 (18.27)
Later (17-18yrs)	06 (1.15)	108 (20.33)	114 (21.48)	12 (2.31)	12 (2.31)	24 (4.62)	138 (26.10)
Total	82 (15.76)	210 (41.55)	292 (57.31)	122 (23.46)	100 (19.23)	222 (42.69)	514 (100)

In Government Schools, the largest group (24.48%) comprised of 13-14 years old and the smallest (11.35%) of 15-16 years old. Similarly, in private Schools, the largest group (31.15%) comprised of 13-14 years old and the smallest (4.62%) of 17-18 years old.

Table 3: Prevalence of Overweight and Obesity in school sectors

BMI	Gender	Type of School				Total	
		Government School		Private School			
		N	%	N	%	N	%
Over Weight	Girls	49	17	28	13	77	15
	Boys	13	4	37	17	50	10
Obesity	Girls	167	56	68	31	235	46
	Boys	67	23	85	39	152	29
Total	Girls	216	73	96	44	312	61
	Boys	80	27	122	56	202	39

Total	296	100	218	100	514	100
Gender $\chi^2 = 37.256$ p=.000*	BMI $\chi^2 = 5.310$ P=.021**					

Table 3 shows the prevalence of overweight and obesity among school going adolescents. Total study population In Government Schools, among girls, 49 were overweight and 167 were obese was higher when compared with 13 overweight and 67 obese boys. Similarly, In private Schools, Among boys, 37 were overweight, 85 were obese when compared to 28 overweight and 68 obese. An Association of BMI with both gender and schools (Over weight and obesity) was statistically significant ( $p < 0.00$ ). Girls from Government schools were found to be overweight and obese than the girls from Private schools. On the contrary, Boys from Private schools were overweight and obese than boys from Government schools

The prevalence of overweight and obesity was higher among adolescents from private than government schools

(13.7% and 5.8% vs. 3.8% and 0.8%). In both types of schools prevalence of overweight was higher among male than female. In government prevalence of obesity was higher among female, whereas in private it was higher among male.

**V. DIETARY PATTERN OF THE SELECTED SUBJECTS**

**Familial history**

Parental obesity can be a significant factor in predicting the development of obesity in adolescents (Strauss & Knight, 1999).Whitaker, P.C., & Dietz, W.H. (1998) have reported that parental obesity increased the risk of childhood obesity by twofold to threefold at all ages, most likely because the influence of parental obesity is the result of a mixture of genetic and environmental influences.

**Table 4: BMI with Member obese distribution**

Familial History	Girls (N=312)				Boys (N=202)				Total	
	Over Weight		Obese		Over Weight		Obese			
	N	%	N	%	N	%	N	%	N	%
Yes	38	7	152	30	36	7	86	17	312	61
No	39	8	83	16	14	3	66	13	202	39
Total	77	15	235	46	50	10	152	30	514	100
If YES										
Father	13	34	70	46	14	39	42	49	139	45
Mother	18	47	44	28	8	22	30	35	100	32
Sister	2	5	17	12	4	11	6	7	29	9
Brother	0	0	6	4	6	17	4	5	16	5
All	5	14	15	10	4	11	4	4	28	9
Total	38	100	152	100	36	100	86	100	312	100
BMI $X^2 = 0.418$ p =.51					Gender $X^2 = 4.629$ p =.32					

It was observed from the above table member obese distribution of the selected subjects that majority of father's (45%). Followed by mother 32%, sisters 9 %, brother 5 % and all member 9% were obese. With respect to girls,fatherswere more obese (22.4 %) than other member's in the family. This statement is applicable for obese boys also (13.4%). Genetic inheritance probably influences a person's chance of becoming fat more than any other factor. These genes enhance the storage of fat when food reduced (Maffeis *et al.*, 2003).Important to control weight in human body.

**Type of Diet followed:**

**Table 5: Type of food consumed by the school-going adolescents**

	Over Weight				Obese			
	Girls		Boys		Girls		Boys	
	N	%	N	%	N	%	N	%
Vegetarian	8	1.5	4	0.7	34	6.6	20	3.8
Non vegetarian	61	11.9	40	7.7	167	32.5	120	23.3
Ova vegetarian	8	1.5	6	1.1	34	6.6	12	2.3
Total	77	15	50	9.7	235	45.7	152	29.6
	$X^2 = .257$		p=.879		$X^2 = 4.24$		p=.120	

Table 5 shows the dietary pattern of the adolescents.Almost 75.5% of taking Non vegetarian food. Comparing Non vegetarian food taking obese category, the girls were outnumbered by 32.5 % than boys (23.3%). These were 11.9% of girls, and 7.7% of boys respectively in over weight categories. Among girls 1.5 % of overweight categories, 6.6 % of obese categories were respectively vegetarian as well as ova vegetarian diet followers. As for as boys only 0.7% were vegetarian,1.1%were ova vegetarian in over weight categories and only 3.8respectively were strict vegetarian,2.3% were ova vegetarian

**Table 6: Type of food non-vegetarian consumed (N = 448)**

	Over Weight				Obese			
	Girls		Boys		Girls		Boys	
	N	%	N	%	N	%	N	%
Fish	19	4.2	8	1.7	33	7.3	24	5.3
Mutton	4	0.8	2	0.4	14	3.1	8	1.7
Chicken	23	5.1	8	1.7	59	13.1	25	5.5
Egg	8	1.7	6	1.3	34	7.5	12	2.6
All	15	3.3	22	4.9	61	13.6	63	14.0
Total	69	15.4	46	10.2	201	44.8	132	29.4
	$X^2 = 10.064$		p=.073		$X^2 = 13.838$		p=.017	

A close look on the BMI / Dietary habit it is understand that those who were taking Non vegetarian food items girls were outnumbered while comparing boys from obese category. Particularly the chicken taking samples were more in girls in terms of 13.1% than boys in terms of 5.5% from obese categories. All non-vegetarian taking samples were more from obese boys 14%, girls 13.6%, than over weight category that is 4.9 % of boys and girls were 3.3%. Followed by this those subject taking fish were coming in the next by 7.3 % in girls , 5.3% in boys from obese categories, among over weight category 4.2 % of girls and 1.7 % of boys. Regarding the mutton taking samples were very less than any other food such as in obese category girls were 3.1%, boy were 1.7 % and in over weight category 0.8 % in girls, 0.4 % in boys . It was assumed that the both gender were highly conscious about their weight and tried to avoiding to take mutton intentionally

## VI. DISCUSSION

In this study, the prevalence of Overweight 95 (18.48%) and obese 315 (61.28%) was found to be higher in Nuclear families, but there was no statistical association between family type and BMI ( $X^2 = 2.575, p > .05$ ). Similarly, rates of approximately 67.6% nuclear and 32.4% joint families were reported by Bharati et al [11]. In a study carried out by Keerthan et al.[12], no significant association was found between type of family and obesity, but the percentage of overweight (3.11%) and obesity (4.15%) was much higher in children staying in nuclear family than joint family (1.89% and 1.42%).

In this study, the prevalence of overweight (10.7%) and obesity (20.8%) was higher in students whose father had post high school Diploma level of education and it is statistically significant with Body mass Index of the children ( $p=0.00$ ). Contrarily, prevalence of overweight (10.7%) and Obesity (23.15%) was found in students whose mother had high school Diploma level of education and it is not statistically significant with Body mass Index of the children ( $p=.057$ ). There was no significant association between fathers' occupation and overweight and obesity of the children ( $p = .64$ ), but, There was a strong association between mothers' occupation and overweight and obesity of the children ( $p = .008$ ; Table 2). Similar findings were reported by Laxmaiah et al. [13] that prevalence of overweight was significantly higher ( $p < 0.05$ ) among the adolescents whose parents' occupation was either service (9.1%) or business (7.4%) than other occupations (3.1%). Bharati et al. [14] found that the risk of overweight/obesity was significantly higher among children whose father and mother had education more than sixth standard, and children whose fathers were service/businessmen.

These findings were also supported by Majeed et al. [15] showing that highest percentage of the study girls were the offspring of highly educated (college and more) mothers (46.86%). However, high percentages (72.6%) of the population under study reported their mothers to be housewives. Member obese distribution of the selected subjects that majority of father's (35.8%). Followed by mother 23.7%, sisters 7.3%, brother 3.1% and all member 6% were obese. With respect to girls fathers were more obese (22.4 %) than other member's in the family. This statement is applicable for obese boys also (13.4%).

Non vegetarian food consumption from girls were outnumbered while comparing from boys and all from obese category girls. Particularly all non-vegetarian foods taking samples were more in boys (14%) than girls (13.6%) obese category. Followed by this chicken taking samples were more in terms of 13.1 and 5.5% in boys respectively. Followed by this those subject taking fish were coming in the next by 7.3 % in girls , 5.3% in boys from obese categories, among over weight category 4.2 % of girls and 1.7 % of boys. Regarding the mutton taking samples were very less than any other food such as in obese category girls were 3.1%, boy were 1.7 % and in over weight category 0.8 % in girls, 0.4 % in boys .

## VII. CONCLUSION:

Preventing obesity among children and adolescents is a public health priority. to stop eating chicken rather than other non-vegetarian foods may promote healthy body weight management among students and reduce the prevalence of overweight and obesity. Non vegetarian consumed between BMI at 5% statically significant ( $p < 0.05$ ).

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