Potential Factors related to BMI among School going adolescents of Madurai District, Tamil Nadu, India

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ABSTRACT
This study aims to recognize essential aspects (related to lifestyle, eating and sedentary behaviours) of overweight and obesity among school-going adolescents of Madurai District, Tamil Nadu. Data were elicited on the physical activity patterns, sedentary practices at home, sleep duration and lifestyle behaviours such as habits of snacking, skipping breakfast, eating in front of television and frequency of eating out. Among 7660 subjects, 514 samples were found to be overweight and obese and analyzed with the suitable statistical tools such as percentage analysis, chi-square test to check the level of significance. 74.4 per cent of obese adolescents were found to have the habit of consuming snacks. The prevalence of Overweight 95 (18.48%) and obese 315 (61.28%) was more significant in Nuclear families. However, there was no statistically significant association between family type and BMI ($\chi^2 = 2.575, p > .05$). No statistical association was found between the BMI and snacking and eating patterns of school-going adolescents. Majority of 364 children expenditure towards snacks are less than Rs.25.

INTRODUCTION
Globally, obesity had nearly tripled ever since 1975. In 2016, Over 650 million adults were obese, including more than 1.9 billion overweight adults. Of these over 650 million were obese. Around 340 million school-going children and adolescents of 5-19 years were neither overweight nor obese in 2016. The prevalence of overweight and obesity among school-going children and adolescents belonging to 5-19 years age group has risen intensely from just 4% in 1975 to over 18% in 2016. The upsurge has arisen similarly among both the genders: in 2016, 18% of girls and 19% of boys were overweight (WHO, 2018). Once, overweight and obesity were believed as a problem of high-income countries but, now it is increasing in low income and middle-income countries, particularly in urban areas.

The vital cause of obesity is an energy imbalance between calories consumed and depleted. Changes in dietary and physical activity patterns are often the outcome of environmental and societal changes globally. Numerous trends in eating patterns have concurred with the increase in obesity rate, including large portion sizes, rise in the intake of food prepared outside the home and increases in the contribution of snacks to total energy intake. But, the impact of obesity in children and adolescents is not yet well understood. In precise, there is a lack of consensus regarding the factors related to BMI to enlighten the development of recommendations and interventions (Larson and Story, 2013).
Table 1: Socio-demographic characteristics of the students and their comparison with Body Mass Index

| Variables          | Overweight (%) | Obesity (%) | Body Mass Index Total (%) | p-value |
|--------------------|----------------|-------------|---------------------------|---------|
| Religious Status   |                |             |                          |         |
| Hindu              | 105 (20.42%)   | 343 (66.73%)| 448 (87.15%)              | $\chi^2 = 2.779^*$ |
| Christian          | 4 (0.77%)      | 14 (2.72%)  | 18 (3.49%)                | df = 2  |
| Muslim             | 18 (3.50%)     | 30 (5.86%)  | 48 (9.3%)                 | =.24    |
| Family Type        |                |             |                          |         |
| Nuclear            | 95 (18.48%)    | 315 (61.28%)| 410 (79.78%)              | $\chi^2 = 2.575$ |
| Joint              | 32 (6.22%)     | 72 (14%)    | 104 (20.22%)              | df = 1  |
| Socioeconomic Status|              |             |                          | =.10    |
| Lower              | 93 (18.09%)    | 297 (57.78%)| 390 (75.87%)              |         |
| Upper Lower        | 32 (6.22%)     | 78 (15.17%) | 110 (21.4%)               |         |
| Lower Middle       | 2 (0.38%)      | 12 (2.33%)  | 14 (2.72%)                |         |

Table 2: Eating patterns of children based on their age and different school sectors

| Adolescent Stage | Family meals | Government School Eating alone | Watching TV | Reading | Private School Eating alone | Watching TV | Reading | Total |
|------------------|--------------|--------------------------------|-------------|---------|----------------------------|-------------|---------|-------|
| Early (13-14 Yrs)| 44           | 6                              | 58          | 12      | 70                         | 17          | 6       | 281   |
| Middle (15-16 Yrs)| 28         | 12                             | 20          | 0       | 10                         | 8           | 0       | 96    |
| Later (17-18 Yrs)| 42          | 10                             | 60          | 2       | 4                          | 9           | 0       | 137   |
| Total (%)        | 114 (22.17)  | 28                             | 138 (26.84) | 14      | 84                         | 34          | 96      | 514   |

This study aimed to 1) observe eating habits, patterns of snacking behaviour (including Pocket money spent on snacks, preference of snacks, frequency of consumption and reason for snacking); and 2) evaluate the association between snacking behaviours, physical activity levels and BMI.

MATERIALS AND METHODS

A cross-sectional study was conducted in Government and Private Schools of Madurai District, Tamil Nadu, which comprised questionnaire framing, quantitative data collection and interpretation. School-going adolescents aged 13-18 years from the Government and private schools of Madurai District, Tamil Nadu were selected irrespective of their religious status, gender and residential area. Later, random sampling methods were utilized on each stratum to obtain the final study sample size (N=514). Eligibility criteria included the following: 1) aged 13–18 years; 2) non-smokers; 3) fluent in either English or Local Language - Tamil; 4) not under medications that affect appetite or body weight; 5) not presently on a weight loss program.

The close-ended questionnaire was framed to capture students’ information concerning meal pattern, living arrangement and food choices. The socio-demographic details of the students (Salma and Ramakrishnan, 2017) and anthropometric measurements such as height and weight were measured using a stadiometer and a digital weighing scale, respectively. Based on these measurements, (Kuczmarski et al., 2000) BMI-for-age child growth charts (Normal weight = $\geq5^{th}$ to <85$^{th}$ Percentile, Overweight = $\geq85^{th}$ to <95$^{th}$ Percentile and Obese = $\geq95^{th}$ Percentile) used to determine adolescent’s BMI for age percentile. The choice and frequency of consumption of snacks, reason for snacking and pocket money spent on snacks were also
### Table 3: Snacking pattern and BMI Comparison of adolescents

| Questions                                                                 | Answer Levels | Over Weight | Obese | Total (%) | P-Value |
|---------------------------------------------------------------------------|---------------|-------------|-------|-----------|---------|
| Q1: How often do you eat snacks apart from regular meals?                 | Once a day    | 35          | 113   | 148 (23.3) | X² = 16.52 df = 10 |
|                                                                          | Twice a day   | 31          | 58    | 89 (14)   | .86     |
|                                                                          | Weekly once   | 14          | 37    | 51 (8.0)  | .12*    |
|                                                                          | Frequently    | 14          | 49    | 63 (9.9)  | .01*    |
|                                                                          | Rare          | 33          | 130   | 163 (25.7) |         |
| Q2: Do you often replace snacks for meals?                                | Yes           | 51          | 191   | 125 (24.3) | X² = 8.10 df = 2 |
|                                                                          | No            | 74          | 198   | 389 (75.7) | .01*    |
| Q3: On what basis do you select the snack?                                | Tasty         | 65          | 212   | 277 (53.89)| X² = 4.78 df = 5   |
|                                                                          | Used it       | 30          | 59    | 89 (17.31)| .01*    |
|                                                                          | Attractive    | 16          | 37    | 53 (10.3) |          |
|                                                                          | Peer pressure | 6           | 40    | 46 (8.9)  |          |
|                                                                          | Advertisement | 12          | 37    | 51 (9.9)  |          |
|                                                                          | Junk/fast food| 18          | 24    | 42 (8.17) | X² = 19.20 df = 12 |
|                                                                          | Bakery foods  | 23          | 77    | 100 (19.45)|        |
|                                                                          | Fried foods   | 14          | 62    | 76 (14.78)|         |
|                                                                          | Sweets        | 10          | 38    | 48 (9.33) |          |
|                                                                          | Artificial    | 2           | 2     | 4 (0.77)  |          |
|                                                                          | Beverages     |             |       |           |          |
|                                                                          | Fresh fruits & vegetables | 6 | 12 | 18 (3.50) |          |
| Q4: What kind of snack you prefer for nibbling?                           | Happy         | 47          | 111   | 158 (30.73)| X² = 12.44 df = 8  |
|                                                                          | Unhappy/Bored | 18          | 18    | 20 (3.86) | .13     |
|                                                                          | Normal        | 34          | 125   | 159 (30.93)|        |
|                                                                          | Watching TV/ Studying | 43 | 124 | 167 (32.49)|        |
|                                                                          | Others        | 1           | 9     | 10 (1.94) |          |
| Q5: When do you feel to eat snacks?                                       | Happy         | 47          | 111   | 158 (30.73)| X² = 12.44 df = 8 |
|                                                                          | Unhappy/Bored | 18          | 18    | 20 (3.86) | .13     |
|                                                                          | Normal        | 34          | 125   | 159 (30.93)|        |
|                                                                          | Watching TV/ Studying | 43 | 124 | 167 (32.49)|        |
|                                                                          | Others        | 1           | 9     | 10 (1.94) |          |
| Q6: How much money do you spend on snacks?                                | >25           | 76          | 214   | 290 (56.42)| X² = 13.95 df = 11 |
|                                                                          | 26 to 50      | 7           | 34    | 41 (7.97) | .23     |
|                                                                          | 51 to 75      | 19          | 45    | 64 (12.45)|          |
|                                                                          | 76 to 100     | 13          | 43    | 56 (10.89)|          |
|                                                                          | <100          | 12          | 51    | 63 (12.25)|          |

*1% level of significance

...elucidated. Additionally, physical activity patterns, sedentary practices at home (time spent in front of the television, playing computer games, studying and writing home works) and time spent in playing games in both school and home were noted. Data analysis was done using SPSS latest version.

### RESULTS AND DISCUSSION

#### Demographic characteristics of respondents

Table 1 represents the Socio-demographic Information of the school going students and their Body Mass Index. Majority of the adolescents belonged to the religion Hindu (87 %) and nuclear families with 80 % including obese with high percentage. Seventy-six percentage of adolescents' belonged to lower socio-economic while twenty-one percentage were classified in upper-lower socio-economic status. These findings were statistically not significant with the BMI of the adolescents. Our study results were contradictory to fewer studies conducted in India (Ramachandra, 2002; Goyal et al., 2010), because of the diversity in the study population. More of our study population belonged...
Table 4: Relationship of Physical Activity, Body Mass Index and preference on Purchasing Snacks

| Physical Activity | Body Mass Index | Preference on purchasing Snacks | Total | P Value* |
|-------------------|-----------------|---------------------------------|-------|---------|
|                   |                 | Costly & Tasty                  | Used It | Attractive in appearance & Hygienic | Suggest by friends | Influenced by Advertisement & Cheaper |       |
| Indoor Games      | Overweight      | 6                               | 6      | 0       | 0      | 0      | 12     | .062  |
|                   | Obese           | 28                              | 12     | 4       | 4      | 2      | 50     |       |
| Outdoor Games     | Overweight      | 24                              | 10     | 4       | 0      | 2      | 40     | .032* |
|                   | Obese           | 92                              | 14     | 4       | 16     | 8      | 134    |       |
| Both              | Overweight      | 43                              | 6      | 8       | 2      | 8      | 67     | .000**|
|                   | Obese           | 107                             | 14     | 12      | 6      | 10     | 149    |       |
| No PA             | Overweight      | 6                               | 2      | 0       | 0      | 0      | 8      | .334  |
|                   | Obese           | 38                              | 2      | 10      | 2      | 2      | 54     |       |
| Total             | Overweight      | 79                              | 24     | 12      | 2      | 10     | 127    |       |
|                   | Obese           | 265                             | 42     | 40      | 28     | 22     | 387    |       |
|                   |                 | 348                             | 68     | 52      | 30     | 32     | 514    |       |

*5 % level of Significance  
*1 % level of Significance

Eating bakery and fried foods was found more frequently among obese students (27.04%) compared to overweight students (7.19%), but it was not statistically significant. Most of the obese students were found to nibble snacks while watching TV, in general, and whenever happy (70.03%), and this was also not statistically significant with the BMI of the children. 56 per cent of adolescents spend less amount to purchase snacks. The common perception of snacking is that snack foods are harmful as it is high in fat and sugar and not appropriate for healthy eating (Astrup et al., 2006). Adolescents habitually choose more salty and crunchy snacks than the other healthier substitutes available since they prefer tasty foods over nutritious foods. Adolescents tend to snack more when they skip their regular meal patterns, and the frequent or regular intake of snacks increases their energy and non-balanced nutrient intakes leading to overweight and obesity (Nicklas et al., 2003).
purchasing snacks and Physical Activity showed significance (p-value .000) statistically at 1% level of significance.

CONCLUSIONS

The present investigation was conducted on school-going adolescent children (13-18 years) from Madurai District, Tamil Nadu state, India. Preventing overweight and obesity among school-going adolescents is a public health privacy improving adolescents knowledge to take balanced nutrition; to eat breakfast and meals regularly; to avoid frequent snacks and fatty food consumption; to stop eating before fullness and to do regular physical exercise may endorse maintaining healthy body weight among students and decrease the prevalence of overweight and obesity.

Author Contribution

We declare that all of the authors mentioned in the article have contributed equal efforts in this research and also for the submission of the article.

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Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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