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Paediatrics Section

Association of Junk Food Consumption, Daily Screen Time and Daily Physical Activity with Overweight and Obesity among School Children Aged 8-10 Years- A Cross-sectional Case-control Study

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ABSTRACT

Introduction: The prevalence of obesity among school children in Kerala is on a steady rise. Consumption of food with high glycaemic index, change in sleep patterns, reduced physical activity and the use of screen has been linked to obesity in children. Published literature on this association is scarce from urban Thiruvananthapuram, hence, the present study.

Aim: To identify the association of various risk factors such as frequency of junk food consumption, dietary preferences, physical activity and daily screen time and weight related disorders among school going children (8-10 years) in Thiruvananthapuram.

Materials and Methods: The present cross-sectional case-control study was conducted in one Rural Government School (Venjaramoodu Government Upper Primary School) and one Urban Private School (S.N. Public School, Chenkottukonam) of Thiruvananthapuram, Kerala, India, and enrolled school going children aged 8-10 years with higher than recommended Body Mass Index (BMI) for age as cases, age and gender-matched children with normal BMI as controls. Participants with BMI above 23rd and below 27th adult equivalent for age and gender were considered overweight and those above 27th adult equivalent for age and gender were considered as obese. A structured questionnaire was sent home with the children, and the parents were requested to answer the questions along with written informed consent. Socio-demographic parameters, anthropometric measurements were obtained by trained staff, dietary habits, and details regarding physical activity and screen usage were collected. Variables were categorised according to the standard recommendations by World Health Organisation (WHO) and Indian Association of Paediatrics (IAP). Variables were expressed as frequencies and the tests of significance used were Chi-square test and Odds ratio, to express the strength of association between parameters. A p-value <0.05 was considered statistically significant.

Results: The mean age of cases and controls was nine years. A total of 708 school children were screened and 352 participants (175 cases and 177 controls) were enrolled in the present study. The BMI of cases was 29.3 kg/m^2 and of controls was 20.2 kg/m^2. Higher than recommended screen time ($p<0.001$), more frequent junk food consumption ($p<0.001$) and lack of physical activity ($p<0.001$) were found to be significantly associated with obesity and overweight. Dietary preference was not associated with obesity or overweight and obesity and overweight was more common in children studying in private schools ($p<0.001$).

Conclusion: Reducing screen time, reducing junk food consumption and increasing physical activity will help in reducing the prevalence of life style diseases among school children. Further evaluation is necessary to determine the factors contributing to the increased prevalence of these disorders in private schools.

Keywords: Body mass index, Coronavirus disease-2019, Dietary preferences, Private schools

INTRODUCTION

The pandemic of childhood obesity has spread its roots in all socio-economic strata over the past few decades. In the past three decades, the global prevalence of obesity has tripled in all age groups, doubled in children and tripled in adolescents [1]. A colossal 200 million school children are either obese or overweight as per the study reports of the International Association for the Study of Obesity and the International Obesity Task Force [2]. The prevalence of childhood obesity has increased to 15-18% which has roughly quadrupled over the past five decades [3]. A study conducted in urban Trivandrum in adolescent school children has demonstrated the prevalence of overweight as 12% and obesity as 6.3% [4].

The delineation of obesity has been ever changing, the recent recommendation defines overweight in adults as having BMI between 25 and 29.9 kg/m^2 and obesity as BMI of more than or equal to 30 kg/m^2 [5]. These definitions do not apply in children under five years of age, where overweight is the weight for height ratio more than two standard deviations of the WHO Child Growth Standards median and obesity is the weight for height ratio of more than three standard deviations of the WHO Child Growth Standards median [1].

Several factors have been attributed to the increased prevalence of disorders of weight. The major pathology is the imbalance between calorie intake and calorie expenditure. Genetic factors have been implicated in the development of obesity, but the role of genetic factors in childhood obesity is limited to less than 5% [6]. Unhealthy food habits such as consumption of fast food, watching television or screen and snacking and even parental food habits also contribute to childhood obesity [7]. Regular consumption of junk foods which are readily available, inexpensive which might not have nutritive value is also associated with weight related disorders [8]. Sedentary lifestyle of parents and children play an important role in development of childhood obesity and an inverse relationship between physical activity and obesity has been demonstrated [9]. Physical inactivity has increased many fold since the outbreak of the global pandemic of Coronavirus Disease-2019 (COVID-19), which led to temporarily

shutting down schools, public parks and crowd control. This has also led to increased use of screens especially among school children [10]. Other psychological factors that can predispose to obesity are depression, anxiety, eating disorders such as anorexia nervosa, bulimia nervosa and impulse regulation and body dissatisfaction [11]. The rates of mood disorders and anxiety disorders is higher among children with obesity than non obese children [12]. Also, the prevalence of eating disorders is higher in obese children, particularly girls [13]. Shreds of evidence of psychological impacts of overweight and obesity among school children, especially girls with little control over eating behaviours has been published elsewhere [14].

Obesity also affects a child's physical health, social interaction and emotional wellbeing. It may be reflected as poor academic performance and avoidance behaviour from social groups. A lower health-related quality of life is seen in obese children and adolescents[15]. Childhood obesity also predisposes to medical disorders such as type 2 diabetes mellitus, non alcoholic fatty liver disease, bronchial asthma, cholelithiasis, menstrual disorders, cardiovascular disorders and allergic manifestations [16]. Most of these medical disorders are preventable by attaining a healthy weight [17]. Parents have an important role in developing and maintaining an active and healthy lifestyle and healthy food habits.

To date, Kerala has made unique and incomparable effort in the field of child healthcare, especially in the past few decades. As any other region, obesity and overweight are growing concerns in Kerala, especially in children post pandemic [18]. This is attributable to the rapid industrialisation, urbanisation and blindly following the dietary habits of developed nations. The present study aims at detecting the prevalence of overweight and obesity and its association with various risk factors from urban Trivandrum and in identifying the risk factors of obesity and overweight among 8-10 years old school children in Thiruvananthapuram, Kerala. The study also aims at demonstrating the association between screen time, physical inactivity and dietary habits with overweight and obesity in these children.

MATERIALS AND METHODS

The present cross-sectional case-control study was conducted in one Rural Government School (Venjaramoodu Government Upper Primary School) and one Urban Private School (S.N. Public School, Chenkottukonam) of Thiruvananthapuram, Kerala, India. The schools were selected randomly and the study was conducted in March 2019, after obtaining approval from the Institutional Ethics Committee (SGMC-IEC No:29/343/01/2018). Consent for data collection and examination was obtained from school authorities and the corresponding Assistant Educational Office, before conduct of the study.

Sample size calculation: A sample size of 117 in control and case groups, was calculated based on the prevalence from previous reference study assuming an α of 0.05, β of 0.2 and 80% power [19]. All the study participants were in the age group of 8-10 years. A total of 708 children (310 from Government schools and 398 from a private schools) were screened for enrollment in the study by anthropometric measurements and BMI.

Inclusion criteria: Participants with BMI above 23rd and below 27th adult equivalent for age and gender were considered overweight and those above 27th adult equivalent for age and gender were considered as obese (cases). Controls were age and gender-matched participants with BMI less than 23rd adult equivalent for age and gender [20].

Exclusion criteria: Children with chronic illnesses (bronchial asthma, epilepsy, renal diseases, collagen vascular diseases, diabetes mellitus, thyroid disorder, cardiovascular disease, congenital anomalies), who were on long-term medications which alter the weight (steroids, salicylates, anti-epileptics), children with obesity secondary to diseases (Cushing's syndrome, hypothyroidism), and those who were unwilling to participate in the study were excluded.

Study Procedure

Data was collected in semi-structured questionnaire which was sent home with the children along with request to the parents for answering the questions. Each participant received the question in English and translation in vernacular. Parents were also required to provide written consent. The physical activity among children is the outdoor activities such as outdoor games, cycling, skipping, walking or jogging was considered as physical activity. Socio-demographic parameters, exercise habits, food habits, time spent on digital media and anthropometric measurements were collected in separate case record forms and were send home with the participants and the parents were requested to fill out the forms and return at the next working day. Written informed consent was obtained along with the case record forms from the parents. Anthropometric measurements were done using standard procedures. Body weight was recorded using a standard digital scale of sensitivity of 0.1 kg and height using a portable stadiometer with a sensitivity of 0.5 centimetres (cms) and BMI was calculated using the formula weight in kilograms/ height in metres. The participants were categorised as normal, underweight, overweight and obese based on age and sex-specific revised IAP BMI chart 2015 [20]. Physical activity cut-off was taken based on WHO recommendation of atleast 60 minutes of moderate to vigorous-intensity physical activity daily i.e., less than seven hours per week and above or seven hours per week [19]. The screen time of the participants were categorised into less than two hours per day and more than or two hours per day as defined by American Academy of Paediatrics [21]. For assessing the dietary habits of participants, the frequency and type of junk food consumption and the type of diet preferred were collected.

STATISTICAL ANALYSIS

Categorical variables are represented as proportions (%) and continuous variables are represented as mean {Standard Deviation (SD)} and median {Interquartile Range (IQR)}. Normality of distribution was assessed using Kolmogorov-Smirnov test. Quantitative variables were compared using the Independent sample t-test and Mann-Whitney U test, one-way Analysis of Variance (ANOVA) and Kruskal-Wallis test. Chi-square test and Odds ratio with 95% Confidence Intervals (CI) were used for detecting the strength of association between categorical variables. A p-value<0.05 was considered statistically significant.

RESULTS

A total of 708 school children were screened and 352 participants (175 cases and 177 controls) were enrolled in the present study. Among the study participants, 59.9% (n=211) were from private schools. The mean BMI of the study participants was 24.7 kg/m^2. The mean BMI of the cases and controls were 29.3 and 20.2 kg/m^2, respectively. Cases were significantly taller (p<0.001), heavier (p<0.001) and had higher BMI (p<0.001).

Significantly higher proportion of cases had daily playtime less than one hour (p<0.001, OR: 3.7, 95% CI 2.4-5.8), daily junk food consumption (p<0.001), daily screen time over one and half hours (p<0.001, OR: 0.2, 95% CI 0.2-0.4) and were from private schools (p=0.008, OR: 0.6, 95% CI 0.4-0.9). Baseline parameters of the study participants is demonstrated in [Table/Fig-1].

Higher proportion of male participants were obese (p=0.006), higher proportion of overweight and obese participants had daily junk food consumption (p<0.001), higher proportion of obese and overweight participants were from private schools and higher proportion of obese and overweight participants were having a daily playtime less than one hour (p<0.001). Association of parameters with weight is demonstrated in [Table/Fig-2].

Parameters	Value	Group	Value	p-value
Mean age-years (SEM)	9 (0.04)	Case (n=175)	9 (0.9)	0.5
		Control (n=177)	9 (0.8)	
Mean height-cms (SEM)	134.1 (0.5)	Case (n=175)	136.1 (0.6)	<0.001*
		Control (n=177)	132.2 (0.6)	
Mean weight-Kgs (SEM)	31.4 (0.5)	Case (n=175)	37.2 (0.6)	<0.001*
		Control (n=177)	25.7 (0.4)	
Mean BMI-Kg/m^2 (SEM)	24.7 (5.2)	Case (n=175)	29.3 (10.5)	<0.001*
		Control (n=177)	20.2 (0.2)	
Female gender (%)	171 (48.3)	Case (n=175)	89 (50.9)	0.4
		Control (n=177)	82 (46.3)	
Non vegetarian diet (%)	336 (95.5)	Case (n=175)	169 (96.6)	0.3
		Control (n=177)	167 (94.4)	
Daily playtime less than 1 hour (%)	156 (44.3)	Case (n=175)	105 (59.3)	<0.001**
		Control (n=177)	51 (28.8)	
Daily junk food consumption (%)	31 (8.8)	Case (n=175)	31 (17.7)	<0.001**
		Control (n=177)	0	
Daily screen time over two hours (%)	174 (49.9)	Case (n=175)	116 (66.3)	<0.001**
		Control (n=177)	58 (32.8)	
Private school (%)	211 (59.9)	Case (n=175)	117 (66.9)	0.008**
		Control (n=177)	94 (53.1)	

[Table/Fig-1]: Baseline parameters of the study participants.
*indicate significant difference between groups using Mann Whitney U test; **indicates significant difference between groups using Chi-square test

Parameters		Weight category			p-value
		Overweight N (%)	Obese N (%)	Normal N (%)	
Gender	Male	43 (23.6)	45 (24.7)	94 (51.6)	0.006*
	Female	64 (37.4)	25 (14.6)	81 (47.6)	
Frequency of junk food consumption	Daily	23 (74.2)	8 (25.8)	0	<0.001*
	Thrice weekly	14 (16.3)	34 (39.5)	38 (44.2)	
	Weekly	54 (25.4)	25 (11.7)	134 (62.9)	
	Never	16 (76.2)	3 (14.3)	3 (14.3)	
Educational institution	Government	38 (26.9)	21 (14.8)	82 (57.7)	0.03*
	Private	69 (32.7)	49 (23.3)	93 (44.1)	
Daily playtime	Less than 1 hour	56 (35.9)	51 (32.7)	49 (31.4)	<0.001*
	More than or equal to 1 hour	51 (26)	19 (9.7)	126 (64.3)	

[Table/Fig-2]: Association of weight and other parameters.
*Indicates significant difference between the groups using Chi-square test

No significant difference was observed between dietary preference of cases and controls (p=0.3) and no association was observed between the dietary preferences and weight category (p=0.3; OR: 0.6, 95% CI 0.2-1.7). Higher proportion of cases had the habit of consuming junk food daily (p<0.001), and significant association was observed between weight and frequency of junk food consumption (p<0.001), probably indicating the lower proportion of normal weight children with daily junk food consumption. Significant association was observed between cases and screen time (p<0.001) and screen time and weight category (p<0.001) probably indicating higher proportion of normal weight participants with daily screen time less than equal to two hours. Significant association was observed between gender and weight category (p=0.006), probably indicating the higher proportion of female participants who are overweight. Significantly higher proportion of obese and overweight participants were from private schools [Table/Fig-2]. Significant association was observed between the physical playtime and cases (p<0.001; OR: 3.7, 95% CI 2.4-5.8) indicating 3.7 odds of encountering cases in participants with playtime of less than one hour daily. Significant association was observed between weight category and playtime (p<0.001).

DISCUSSION

The global prevalence of overweight in children aged 5-17 years as estimated by the International Obesity Task Force (IOTF) is approximately 10% which has doubled in the past decade [18]. The prevalence is unequally distributed with higher prevalence of 30% in developed nations such as United States and less than 2% in impoverished nations of Sub Saharan Africa [19]. The prevalence of obesity was higher among male school children (p=0.006) which is contrasting to expected. This could indicate a reduction in the outdoor activities among male children. No association between age and obesity was observed in the present study.The prevalence of obesity and overweight among school children in India has been poorly studied. The overall prevalence of overweight and obesity among school children from Tamil Nadu is reported to be 4.98% and 2.24%, respectively. The prevalence of overweight and obesity in Mahe was 8.7% and 4.7%, respectively. Though the region is a part of Tamil Nadu, the prevalence is higher than the reported prevalence from Tamil Nadu. This increase in prevalence could be due to geographical factors, since Mahe is surrounded by Kerala. This could cause adaptation of the dietary and life style practices of Keralites which could result in the higher prevalence [22]. Present study demonstrates that it is the need of the hour to conduct more studies on prevalence of weight related disorders, specifically in school children since intervening early can reduce the impact of the obesity epidemic in the next generation.

A total of 52% of girls and 47.5% of boys were either obese or overweight. Higher prevalence of overweight and obesity has been previously reported in female school children [22]. There was no association between non vegetarian diet and obesity or overweight indicating lack of physical activity as the major risk factor for obesity in school children. Daily junk food consumption was significantly higher among obese and overweight children and the frequency of junk food consumption was associated with obesity and overweight. The consumption of high energy food as diet and as frequent snacks coupled with physical inactivity will alter the energy consumption expenditure balance leading to development of obesity and overweight.

Significantly higher proportion (p<0.001) of obese and overweight children had higher than recommended average screen time daily. Higher than recommended screen time promotes weight gain not only by displacing physical activity but also by increasing energy intake in the form of snacking, while watching television [23]. This is habit forming and once the habit sets in it is difficult to intervene. This habit could also be a result of lack of time for the parents which would resort them to use screens as a method of engagement and compensation for the time they cannot contribute to their offspring. This habit could also be due to the practice of engaging kids using digital media while consuming food. This is a predominant drawback of our study since this data from the parents were not collected as a part of our study. A 30-year study in the United Kingdom shows a higher BMI at the age 30 years in participants with higher daily television viewing and also the duration of television use in weekends [24]. For each additional hour of television viewed on weekends at age five years, the risk of adult obesity increases by 7% [24]. A long-term follow-up study done in 1000 participants from New Zealand, has shown that the average week night television time was a strong predictor of higher BMI at age 26 years [25]. Reducing the screen use hours can be a viable complementary strategy for promoting physical activity among children and adolescents. The present study demonstrated that a screen time of less than one and half hours daily is associated with a 0.2 Odds of developing obesity and overweight which were consistent with other studies which showed an adjusted odds of being overweight for children, who viewed television more than or equal to 1.5 hours as 19.6, when compared to children who watched television less than 45 minutes daily [25].The risk of obesity increased by 12% with

every hour per day increase in television time [26]. Strictly adhering to recommended screen time has a protective effect in preventing overweight and obesity. The daily duration of playtime was inversely associated with obesity and overweight [27]. These findings were established among school children previously [28]. In contrast to popular belief that, non vegetarians are at higher risk of developing obesity and overweight, the present study did not demonstrate such an association. This shows that the diet is not the villain, but reduced physical activity and higher screen time are. This could also indicate the increasing influence of carbonated drinks and snacking in the body weight. Significantly lower odds of 0.6 was observed in students who went to government schools. This indicates children belonging to higher socio-economic strata have more chance of studying in private schools and to be stationed in urban areas are at higher risk of developing obesity and other lifestyle diseases. Similar results have been demonstrated by Ramachandran A et al., [29].

India is a country with a tremendous urban, rural and rich, poor divide, the prevalence in urban rich being higher than rich in rural areas and the poor communities. The IAP has put forth various publications pertaining to fast food and junk food consumption in children. The IAP has also suggested an acronym 'JUNCS' for the items that produce this potentially lethal habit-forming diet which include Junk food, ultra-processed foods, nutritionally inappropriate foods, Caffeinated, Coloured, Carbonated foods and beverages, and sugar-sweetened beverages [30]. All children who consumed the JUNCS daily were either overweight or obese.This observation is an eye opener showing the depth junk food culture has crept into our society, even in lower socio-economic strata contrary to the general notion. The umpteen number of bakeries in and around every nook and corner of the country, irrespective of the geographic locations, easy availability of a wide variety of tasty zero nutritive value foods and the substantial reduction in consumption of home-made food has caused a dramatic increase in this pandemic. Fibre and micronutrient rich food such as fruits and vegetables are considerably lower in children who consume fast food regularly. This could also lead to micronutrient deficiency, constipation and other diseases. Since fat is less satiating than carbohydrates, portion control while consuming junk food is difficult to maintain. Fats are stored more efficiently than carbohydrates and proteins which eventually result in the development of obesity and overweight. The findings from Kerala are surprising, Kerala being a state with high educational status, with egalitarian healthcare policies of the state government and active intervention of almost all diseases. These findings necessitate the need for active intervention in the healthcare strata, stringent regulations in food additives, colour and components. Necessity for regulating the diet available in schools canteen, cafeteria and nearby vicinity could be a possible solution to this pandemic along with educating parents and children regarding the consumption of JUNCS and also regarding the harmful effects of screen time in growth and development. This also draws insights into the need for mandating the playtime in public and private schools alike. Parental initiative in home-based strategies regarding the diet and physical activity is essential in curbing this epidemic. Encouraging children to have regular meals from home including breakfast could reduce the snacking behaviour. Educating children regarding healthy life styles especially by healthcare personnel, preferably doctors could influence the behaviour of children. Also, identifying children at risk using screening programme and intervening early could increase the longevity and well-being of our future generation.

Limitation(s)

The present study did not collect data from the participants parents, since parental behaviour plays a major role in development of obesity.

CONCLUSION(S)

Overweight and obesity are significantly associated with lower daily physical activity, higher daily screen time and the frequency of junk food consumption. Dietary preference was immaterial in overweight and obesity. Higher prevalence of obesity and overweight were observed in private schools necessitating the need for intervention and regulation of the diet available in the school and nearby premises. It is high time to implement large scale corrective measures for preventing lifestyle disorders among children.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
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