

## Obesity and Physical Activity Patterns among Adolescent School Students in Kerala

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Received: 25-02-2024 / Revised: 23-03-2024 / Accepted: 20-04-2024

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Conflict of interest: Nil

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### Abstract:

**Background:** The pattern of inactivity begins early in life, making the promotion of physical activity among children crucial. This study was conducted in the schools of the Kottayam Municipal Area to assess the level of physical activity in adolescents. Another objective was to determine the prevalence of hypertension in this age group.

**Materials and Methods:** The present study was conducted in an urban area of the Kottayam district in Kerala. Schools were stratified into three categories: Government, aided, and unaided. A cluster sampling technique was employed, and data were collected after obtaining informed consent.

**Results:** The study revealed a higher prevalence of obesity among children who do not engage in school play, do not participate in Physical Education programs, and spend more time watching TV and using computers. Additionally, there was a significant association between hypertension and childhood obesity.

**Conclusion:** School intervention programs are the most effective approach to preventing overweight and obesity. Allocating more hours to physical education is essential. Additionally, regular monitoring of blood pressure in children with obesity is crucial.

**Keywords:** Obesity, Overweight, Physical activity, Adolescent, Hypertension

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### Introduction

The human body, broadly speaking, is shaped by nutrition. Historically, a fat child was often seen as a sign of health, indicating a child likely to withstand the rigors of undernourishment and infection. However, unlike in the past, today obesity or overweight in childhood is considered a significant health risk condition. It can lead to numerous health problems both during childhood and later in adulthood.

The pattern of inactivity often starts early in life. Therefore, promoting physical activity among children is crucial. Addressing the current epidemic of cardiovascular disease requires a focus on primordial prevention [1].

Kerala has achieved remarkable advancements comparable to developed countries in the realm of women's and children's health over the past few decades. While India as a whole continues to grapple with communicable diseases, Kerala stands out with its commendable health status compared to Western standards. However, the state is currently undergoing an epidemiological transition

where non-communicable diseases are becoming more prevalent.

The rise in popularity of fast foods, sedentary lifestyles, decreased participation in sports, and increased time spent watching TV and using computers have all contributed to this shift in lifestyle. In this context, the present study was conducted in schools within the Kottayam Municipal Area to assess the level of physical activity among the adolescent age group. Another objective of the study was to determine the prevalence of hypertension within this population.

### Materials and Methods

**Study Area:** This study was conducted among selected high schools in the Kottayam Municipal area, located in Kerala, South India.

**Study Design:** Cross-sectional study

**Sampling:** The Kottayam Municipal area has 15 high schools, categorized into Government, aided, and unaided schools. This includes 2 Government schools, 11 aided schools, and 2 unaided schools.

The number of students in the 8th, 9th, and 10th grades in each school was ascertained, totaling 5,840 students. Each school was considered one cluster, with a total of 6 clusters covered.

Since there were only 2 schools each in the Government and unaided categories, 1 Government school and 1 unaided school were selected randomly. The selected Government school had only 29 high school students, all of whom were included in the study. The selected unaided school had 204 students, all of whom were also included. The cumulative population of high school students in the aided school category was 5,212. Four clusters were identified from this population, and all high school students in the selected clusters were included.

**Sample size:** The sample size was calculated using the formula [2]

$$n = \frac{z^2 \cdot p \cdot q \cdot N}{e^2 (N-1) + z^2 \cdot p \cdot q} = 423$$

(N=5840, z=1.96, Prevalence(p)= 5%, q=1-p, and acceptable error of 2% at 95% confidence limits) where N is the total population, 'p' is the prevalence of the factor under study (obesity), 'q' is (1-p) and 'e' is the acceptable error. According to a study conducted by Ambily G. Unnithan et al among school going children in Thiruvananthapuram district, the prevalence of obesity was found to be 4.99%<sup>3</sup>. So 'p' was taken as 5%. By applying the design effect of 2, the

sample size is estimated to be 846 high school children.

**Data Collection and Analysis:** Consent was obtained from the head of the institution prior to data collection. The data was collected using a semi-structured interview schedule. To measure the weight of the students, a weighing machine with a precision of 0.5 kg was utilised. Height measurements were taken with the students standing on a level surface without shoes, and the height in centimeters was recorded.

To estimate overweight and obesity among the study population, BMI-for-age Z scores (WHO, 2007) were employed. A child whose Z BMI-for-age fell between +1 and +2 standard deviations from the reference population was defined as overweight, while a Z BMI-for-age exceeding +2 standard deviations was classified as obese. WHO Anthro Plus software version 1.0.2 was utilized for calculating Z scores. [3]

Further analysis was conducted using SPSS statistical software version 26.0. The chi-square test was employed to assess the level of significance.

**Ethical Considerations:** The study received approval from the Institutional Ethics Committee. Consent for participation was obtained from school authorities through an informed written consent form.

## Results

### 1. Physical Activity (Table 1)

**Table 1: Nutritional status and Physical activity**

	Z-BMI for age		$\chi^2$	p-value
	Obesity and overweight (%)	Not overweight (%)		
<b>Mode of Conveyance</b>				
By foot	23(14.7%)	133(85.3%)	0.194	0.660
Vehicle	135(16.1%)	701(83.9%)		
<b>Play in School</b>				
Yes	28(11.4%)	218(88.6%)	5.047	0.025
No	130(17.4%)	616(82.6%)		
<b>Physical Education Training</b>				
Yes	48(10.5%)	410(89.5%)	18.852	0.0001
No	110(20.6%)	424(79.4%)		
<b>Playing after School hours</b>				
Yes	48(11.7%)	361(88.3%)	9.131	0.003
No	130(17.4%)	616(82.6%)		
<b>Exercise for Physical fitness</b>				
Yes	73(15.0%)	413(85.0%)	0.585	0.444
No	85(16.8%)	421(83.2%)		
<b>Calorie expenditure per day during exercise</b>				
<500Cal	143(16.0%)	749(84.0%)	1.733	0.420
500-1000Cal	15(16.5%)	76(83.5%)		
>1000Cal	0(0.00%)	9(100.0%)		

<b>TV Watching</b>				
<1hr	56(13.8%)	350(86.2%)	7.8	0.020
1-2hr	57(14.8%)	327(85.2%)		
>2hr	45(22.3%)	157(77.7%)		
<b>Computer use</b>				
<1 hr	134(14.6%)	782(85.4%)	19.350	0.001
1-2hr	13(25.5%)	38(74.5%)		
>2hr	11(44.0%)	14(56.0%)		
<b>Study hours</b>				
<3hours	97(15.3%)	537(84.7%)	0.517	0.472
>3hours	61(17.0%)	297(83.0%)		
<b>Duration of sleep</b>				
<8hours	139(16.4%)	711(83.6%)	0.803	0.370
>8hours	19(13.4%)	123(86.6%)		

The age distribution of the study population varied from 12 years to 18 years. The total number of males in the present study was 447 and the number of females was 545. According to the present study, the prevalence of obesity was 5.1%, while the prevalence of overweight stood at 10.8%

The present study showed that the combined percentage of children who were obese and overweight was 14.7% among those who walked to school, while it was 16.1% among those who commuted by vehicle.

The total percentage of children who were obese and overweight among those who play in school was 11.4%, whereas among those who do not play in school, it was 17.4%. This disparity was observed to be statistically significant

The study revealed that the total percentage of children who were obese and overweight among those who attended the Physical Education Training (PET) Programme in school was 10.5%. Conversely, 20.6% of children were observed to be obese and overweight among those who were not participating in the PET Programme. This difference was also determined to be statistically significant.

The total percentage of children who were obese and overweight among those who played after school hours was 11.7%. For those who did not play after school hours, it was 18.8%.

In the study, it was found that the total percentage of obese and overweight children among those who were doing physical exercise was 15%. It was also noted that among those who were not doing exercise, 16.8% were overweight and obese.

Assessment of daily calorie expenditure by children during exercise was undertaken. Common physical

exercises performed by children during their leisure time included cycling, jogging, running, swimming, skipping, dancing, and other activities like push-ups. Each child was asked to report the frequency and number of hours spent on each activity, and the daily energy expenditure was then calculated accordingly.

In the study, it was found that the total percentage of obese and overweight children among those spending less than 500 calories per day was 16%. Among those spending 500-1000 calories per day, it was 16.5%<sup>1</sup>. In the group where the calorie expenditure was more than 1000 calories per day, no child was obese or overweight (0%).

In the present study, the total percentage of children who were obese and overweight among those who watched TV daily for less than 1 hour was 13.8%. In the case of those who watched for 1-2 hours, it was 14.8%, and it was 22.3% among those who watched TV for more than 2 hours daily.

The total percentage of children who were obese and overweight among those who used computers daily for less than 1 hour was 14.6%. Among those who used a computer for 1-2 hours, it was 25.5%. The proportion was 44% among those who sat at the computer for more than 2 hours daily

The total percentage of children who were obese and overweight among those who studied for less than 3 hours was 15.3%. For those who studied for more than 3 hours, it was 17%.

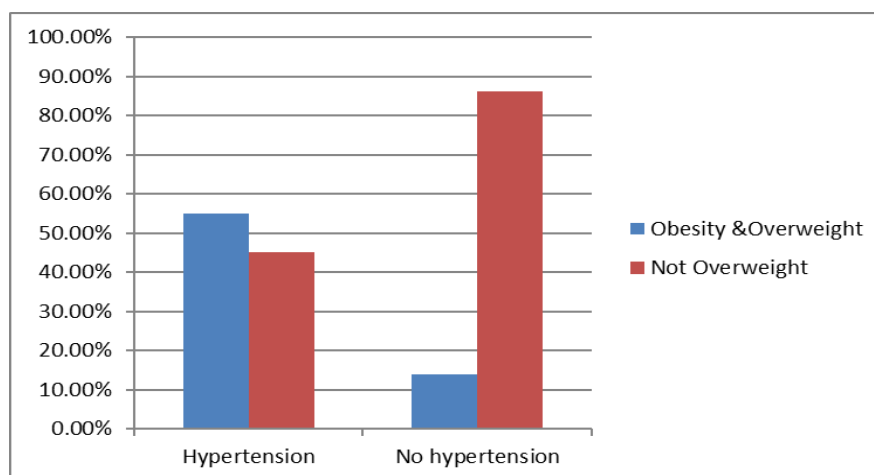
In the present study, the total percentage of children who were obese and overweight among those who slept less than 8 hours was 16.4%. For those who slept more than 8 hours, it was 13.4%.

## 2. Hypertension (Table 2)

**Table 2: Nutritional status and Hypertension**

	Z-BMI for age		$\chi^2$	p-value
	Obesity and overweight (%)	Not overweight (%)		
<b>Hypertension</b>				
Yes	28(54.9%)	23(45.1%)	60.989	0.0001
No	130(13.8%)	811(86.2%)		

The total percentage of children who were obese and overweight among those with significant hypertension was 54.9%. Among those who were not hypertensive, it was 13.8%. This apparent difference was found to be statistically significant.

**Figure 1: Diagram Showing the Nutritional Status of the Study Population in Relation to Hypertension**

### Discussion

The WHO refers to physical activity as "any bodily movement produced by skeletal muscle that results in a substantial increase over the resting energy expenditure" [4]. Decreased physical activity and/or increased sedentary behaviour play an important role in weight gain and the development of obesity.

As per the present study, the prevalence of obesity and overweight was higher among students who come to school by vehicle. This could be because a majority of the students may be using the vehicle for conveyance thanks to rapid urbanization. Similar findings were reported in studies conducted by Thankachy Yamini Ramachandran among adolescents in Thiruvananthapuram district [5]. A lower prevalence of overweight and obesity among children who walked to and from school when compared to those who went to/from school by bus was reported in studies conducted by Prof. Dr E.G. Schouten et al. in China [6].

Our study showed that obesity is more prevalent among students who do not engage in play at school. Children may have limited time for physical activity like playing during school hours due to rigorous academic activities. Additionally, obese children may refrain from participating in play activities due to mobility challenges. This cycle of inactivity among adolescents is a

significant contributing factor to the increasing trends in overweight and obesity.

The current study also revealed that obese children are less likely to attend the Physical Education Training program at school. Physical education, when provided at school, serves as an effective means to promote physical activity and cultivate fitness among children.

A higher prevalence of obesity was noted among those who do not engage in play after school hours. The reasons for this lack of play may include limited free space for recreational activities and increased television viewing and computer usage, which promote a sedentary lifestyle. A similar association was observed in a previous study conducted by D.R. Bharati, P.R. et al. [7] in Wardha City, India. Physical inactivity promotes obesity, insulin resistance, and diabetes, whereas physical activity and exercise mitigate these risks.

Assessment of calorie expenditure per day during exercise was conducted for children. Common physical exercises performed during leisure time included cycling, jogging, running, swimming, skipping, dancing, and other activities like push-ups. Each child was asked to specify the frequency and number of hours spent on each activity, and the energy expenditure per day was then calculated [8].

In the study, it was observed that the total percentage of obese and overweight children among those expending fewer than 500 calories per day was 16%. Among those expending 500-1000 calories, it was 16.5%. In the group expending more than 1000 calories, no child was obese or overweight (0%). This difference was not found to be statistically significant. It's possible that some of the obese and overweight children may be engaging in exercise to reduce their weight. Studies conducted by Supreet Kaur et al. among school students in Delhi also demonstrated a negative correlation between obesity and physical exercise [9]

Television viewing has a notable impact on metabolic rate, potentially contributing to the link between obesity and the amount of time spent watching TV [10]. Additionally, it displaces the time children allocate to physical activities, leading to increased energy consumption through excessive snacking and eating meals while watching TV [11, 12]. Moreover, exposure to food advertisements during television viewing can influence children to make unhealthy food choices [13]. Numerous studies have highlighted a positive association between the duration of television viewing and the increased prevalence of obesity in children [14,15,16]

Sitting at a computer and playing video games are very common among school students. These sedentary habits contribute to excessive weight gain and obesity. Similar findings were reported in a study conducted by T. Aggarwal et al. among adolescents in Ludhiana, Punjab [17].

Our study showed that obesity is more prevalent among those who sleep less than 8 hours. A study conducted by Giugliano R. et al. also demonstrated an inverse correlation between obesity and daily sleeping hours [18]. One reason for this may be that less sleep at night makes children drowsier and less active during the daytime, leading to fewer calories burned. It is also observed that individuals with short sleep duration have reduced leptin and elevated ghrelin levels [19]. These differences in leptin and ghrelin likely increase appetite, possibly explaining the increased BMI observed with short sleep duration.

In our study, high blood pressure was noted among students who were obese and overweight. Several pathophysiological pathways may explain why adiposity is associated with elevated BP and hypertension. The most important factor is the dysfunctional adipocyte and neurohormonal activation of the sympathetic nervous system [20]. Similar results were reported in studies conducted by Chu, N.F. in Taiwan [21], and Ximenna et al. in the USA [22].

## Summary and Conclusion

The study was conducted among high school students in the Kottayam Municipal area. The study revealed a higher prevalence of obesity in children who are not playing in school, not attending Physical Education Programmes, and who spend more time watching TV and using computers. Physical activity patterns significantly influence the physiological regulation of body weight. Children who are physically active tend to remain active in adulthood, so encouraging young children to engage in a variety of general activities is especially important. Energy expenditure can be increased more effectively through general activity and play.

Obese children are particularly sensitive to peer attitudes towards body shape and exercise performance. Making physical activity enjoyable by offering a variety of activities and providing positive reinforcement for their achievements may help in adherence to exercise programmes. School intervention programmes are the best approach to preventing overweight and obesity, which can be facilitated through active participation by teachers and school management. Unfortunately, Physical Education Training is absent in many schools. More hours should be allocated to physical education, and all students should be encouraged to participate in these activities.

The present study also found a significant association between hypertension and childhood obesity. Therefore, blood pressure should be monitored in children with obesity. Based on this, Health Cards may be issued to the students to track their health metrics and ensure regular monitoring.

## Limitations of the Study

Since the study was a cross-sectional survey, no causal relationships can be established. Additionally, recall bias among children may have confounded some of the results.

**Non Author Contribution:** NIL

**Funding:** NIL

**Acknowledgement:** Authors acknowledge the invaluable support of all the students who participated in this study. We extend our heartfelt gratitude to the heads of the school and other staff for their cooperation.

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