OPEN ACCESS

Journal of Advances in Sports and Physical Education
Abbreviated Key Title: J Adv Sport Phys Edu
ISSN 2616-8642 (Print) |ISSN 2617-3905 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Original Research Article

An Investigation of the Body Mass Index and Body Fat Percentage of Students Commuting to School Using Three Different Travel Modes

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DOI: 10.36348/jaspe.2022.v05i07.002 | **Received:** 17.06.2022 | **Accepted:** 13.07.2022 | **Published:** 16.07.2022

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Abstract

The study's purpose was to conduct a comparison of selected physiological measures among students who commute to school via three different modes of transportation (Bicycling, Walking, and Motor Vehicles). Initially, a total of 600 school-going boys (N = 600) were chosen as study participants. Class VIII to XII grade school male students aged 14 to 18 years were purposefully selected as study subjects from seven secondary schools in the Birbhum district of West Bengal, India. Each group had 200 participants: N = 200 for walking, N = 200 for bicycling, and N = 200 for motor vehicles. A category-wise number of subjects were selected from the different schools. The data was calculated by descriptive statistics. For all independent variables, which were computed by using SPSS, one way ANOVA test followed by t-tests were used. As a result, students traveling to school by motor vehicle, as non-active commuters, had a significantly higher Body Mass Index (21.81) and percent Body Fat (16.03) than the other two active commuters, namely the walking and bicycling groups. According to current researchers, students who commute from their homes to school each day may use walking as their main form of transportation. The researchers also concur that if the school is reasonably close to the home, walking is a great form of transportation for students.

Keywords: Body Mass Index, Fat Percentage, Bicycling, Walking, Motor Vehicles, Transportation, School Boys.

INTRODUCTION

Children in the ancient period stayed in schools and received their education and life skills from the teachers because they did not have to travel far from home to obtain their knowledge. Living and working for any period of time in a culture that is different from home can help prepare students for college in ways more profound than any sleep-away camp or vacation can (*Top 10 Benefits Students Gain From Traveling*, 2013). On the other hand, in the current society, which is entirely based on computer technologies, the society's future is in grave jeopardy because it is surrounded by modern devices and automobiles. Every step and everywhere, children employ a comfortable mode of transportation. They used a variety of forms of transportation to get to school, including autos, bicycles, and walking. However, required movement of the level Physical fitness is one of the aspects that affect performance. As the basic foundations of long- term work are based on muscle endurance and a healthy lifestyle, strong muscles and an active lifestyle influence movement efficiency (Islam, 2018). Physical activity levels around the world are gradually declining. For teenagers to become physically active, the World Health Organization (WHO) recommends that they engage in at least 60 minutes of daily moderate-to-vigorous physical activity. According to the World Health Organization (WHO), 77.6% of boys and 84.7 percent of girls aged 11 to 17 are physically inactive. This is alarming because physical exercise is linked to a variety of health benefits, including body fat percentage, Body Mass Index, cardiovascular, bone, metabolic, and mental health (World Health Organization (WHO), 2020). Physical activity recommendations for children and teenagers recommend that all young people engage in at least one hour of moderate-intensity physical activity every day (McKee *et al.*, 2007). Increasing people's levels of

physical activity has been regarded as an key aspect of any future public health plan (Fox *et al.*, 2004).

Early research showed that the intervention was successful in increasing the mean distance travelled by active mode and decreasing the mean distance travelled by passive mode on school trips (McKee *et al.*, 2007). Walking and bicycling to school (active commuting) has been advocated as a way of promoting youth physical activity and lowering obesity rates (Sirard *et al.*, 2008). The present study influenced a previous study that found-except in the car group, where children who lived close to school had much lower cardiorespiratory fitness (CRF) than those who lived further away, commuting distance had only a little effect on CRF. Children who reside within walking or driving distance of school should be targeted through active transportation strategies (Jurak *et al.*, 2021). Over the last two decades, China's proportion of students walking or cycling to school has declined due to the fast expansion in the number of automobiles (Zhu *et al., 2021)*. Similarly, in India, three different modes of transportation (bicycling, walking, and motor vehicles) are commonly utilized to commute to school. Therefore, the aim of the present study was to compare the BMI and body fat percentage of students commuting to school by three different travelling modes. As the current author wishes to learn which form of transportation is the healthiest for students in India?

METHODS

Selection of the Subject

For the purpose of the study, initially Six hundred (N = 600) school going boy's students were selected as subject for the study. 14 to18 years in age ranged class VIII to class XII grade school male students were purposely selected from seven secondary schools located at Birbhum district in West Bengal, India. Each group consisted of 200 subjects, i.e. Walking group N = 200, Bicycle group N = 200 and Motor vehicle group N = 200. Category-wise number of subjects was selected from the different schools. The data was calculated by descriptive statistics, for all independent variables ware computed by using SPSS, one way ANOVA test followed by t-tests were used. The level of significance was set at the 0.05 level.

Variables-Test and Criterion Measure

BMI and Body fat% was tested in open classroom. The height of the subject was measured to the nearest cm. The weight was recorded in kilograms from the weighing scale. The Body Mass Index was calculated from the following formula: BMI = Bodyweight in kg / height in meter^2. The body fat % was measured by 4 side skin fold caliper, the score was recorded in mm. Researchers used the standard Harpenden Skinfold Caliper manufactured by "Jhon Bull, British Industries Limited, England". The spring pressure of the skinfold caliper was 10gms/mm^2.

Design of the Study

The present investigation was a descriptive research design. Purposive sampling technique was used in this study as the focus of the study was to compare the selected physiological measures among the walking, bicycling and motor vehicle groups; therefore, 600 male students from seven schools located at Birbhum district, West Bengal, 200 in each mode of commuting category (walking, bicycling, and motor vehicle) were purposely selected.

RESULT

Statement of Statistical Measures (Mean and SD) in BMI & %BODY FAT of the Selected Three Groups

Table 1: Descriptive Statistics of BMI &%BODY FATof the Selected Three Groups

Measures		Groups		
		Walking (N=200)	Bicycling (N=200)	Motor Vehicle (N=200)
DISTANCE OF COMMUTING TO SCHOOL (Km)		1.94 ± 0.81	2.33 ± 0.78	4.16 ± 1.51
PERSONAL DATA	Height (cm)	1.59 ± 0.05	1.58 ± 0.04	1.59 ± 0.04
	Weight (Kg)	53.25 ± 3.50	51.99 ± 2.61	55.11 ± 3.36
PHYSIOLOGICAL MEASURES	BMI (Kg/m^2)	21.18 ± 1.27	20.90 ± 1.17	21.81 ± 1.23
	% Body Fat	12.58 ± 0.75	12.93 ± 0.74	16.03 ± 0.85

Interpretations for the measures of the selected test items of the three male School going StudentsWalking, Bicycling, and Motor Vehicle Commuting groups (N=600):

Distance of Commuting to School

From the Table-1, it was observed that the mean distance travelled by the Walking groups (N=200), Bicycling groups (N=200), and Motor vehicle groups (N=200) to their school regularly were 1.94 ± 0.81 Km, 2.33 ± 0.78 Km, and 4.16 ± 1.51 Km respectively.

Height

It was evident that the mean height of the three commuting groups i.e. Walking, Bicycling, and Motor vehicle were 1.59 ± 0.05, 1.58 ± 0.04, and 1.59 ± 0.04 cm respectively. Selected subjects were exactly equal

height. Mean height of the total subjects (N = 600) was 158 ± 0.04 cm that falls just at the bottom of the range of 159.9 – 173.6 cm, reference body height for the Indians, recommended by **ICMR -2020 for 14 to 18 years boys**.

Weight

It was observed from the Table-1 that the mean weight of the three commuting groups i.e. Walking, Bicycling, and Motor vehicle were 53.25 ± 3.50, 51.99 ± 2.61, and 55.11 ± 3.36 Kg respectively. Motor vehicle groups were heavier than the Bicycle and Walking groups. Mean body weight of the total subjects (N = 600) was 53.45 ± 3.43 Kg that falls within the range of 48.2 – 61.6 Kg, reference body weight for the Indians, **recommended by ICMR -2020 for 14 to 18 years boys.**

BMI

From the Table-1, it was observed that the mean BMI of the Walking, Bicycling, and Motor vehicle commuting groups were 21.18 ± 1.27, 20.90 ± 1.17, and 21.81 ± 1.23 Kg/m^2 respectively. All three groups were possessing within normal range.

% Body Fat

It was evident from the Table-1 that the mean % body fat of the Walking, Bicycling, and Motor vehicle commuting groups were found to be 12.58 ± 0.75, 12.93 ± 0.74, and 16.03 ± 0.85 respectively. Motor vehicle group possessed more amount of body fat than that of the Walking and Bicycling groups.

Table 2: ANOVA among the Walking, Bicycling and Motor Vehicle commuting group students for the personal data

Measures	Source	Sum of Squares	Df	Mean Squares	'F'
Height	Between Groups	.014	2	0.007	3.812*
	Within Groups	1.126	597	0.002	
	Total	1.140	599		
Weight	Between Groups	990.176	2	495.088	48.865**
	Within Groups	6048.622	597	10.132	
	Total	7038.798	599		

At 2/597 df 'F' at * 0.05 level = 3.01and at ** 0.01 level = 4.65

From the Table-2, it was observed that the F-values for the Height (3.812) among the Walking, Bicycling, and Motor Vehicle commuting groups were found significant at the 0.05 level and the F-value for the Weight (48.865) was significant at the 0.01 level. As the F-values in ANOVA test was found significant, therefore, there was necessity to find out the significance of differences between the groups.

As the F-values for the Height, and Weight were found to be significant either at the 0.05 level or at the 0.01 level of confidence, the researcher intended to find out the significance of differences in the mean scores in Height, and Weight between the Walking & Bicycling, between the Walking & Motor Vehicle, and between the Bicycling & Motor Vehicle commuting group students using t-tests and were presented in the Table-3.

Table 3: ANOVA for the scores in Physiological measures among the Walking, Bicycling and Motor Vehicle commuting group students

Measures	Source	Sum of Squares	Df	Mean Squares	'F'
BMI	Between Groups	87.915	2	43.958	29.313**
	Within Groups	895.268	597	1.500	
	Total	983.183	599		
% Body Fat	Between Groups	230.727	2	115.363	188.167**
	Within Groups	366.016	597	0.613	
	Total	696.743	599		

At 2/597 df 'F' at * 0.05 level = 3.01 and at 0.01 level = 4.65**

From the Table-3, it was observed that the F-values for the BMI (29.313) and % Body Fat (188.167) among the Walking, Bicycling, and Motor Vehicle commuting groups were found significant at the 0.01 level. As the F-values in ANOVA test was found significant, therefore, there was necessity to find out the significance of differences between the groups.

As the F-values for the BMI, and % Body Fat were found to be significant at the 0.01 level of confidence, the researcher determined to find out the significance of differences in the mean scores in all physiological measures between the Walking & Bicycling, between the Walking & Motor Vehicle, and between the Bicycling & Motor Vehicle commuting group students using t-tests and were presented in the Table-4.

Table 4: Significance of differences in mean scores in Physiological measures among the Walking, Bicycling and Motor Vehicle commuting group students by t-tests

Measures		Mean Scores	Mean Scores	Mean Difference	SE_D	't'
BMI	Between Walking & Bicycling	Walking (21.18)	Bicycling (20.90)	0.28	0.122	2.30*
	Between Walking & Motor Vehicle	Walking (21.18)	Motor Vehicle (21.81)	0.63	0.122	5.17**
	Between Bicycling & Motor Vehicle	Bicycling (20.90)	Motor Vehicle (21.81)	0.91	0.122	7.48**
% Body Fat	Between Walking & Bicycling	Walking (12.58)	Bicycling (12.93)	0.35	0.134	2.61**
	Between Walking & Motor Vehicle	Walking (12.58)	Motor Vehicle (16.03)	3.45	0.134	25.75**
	Between Bicycling & Motor Vehicle	Bicycling (12.93)	Motor Vehicle (16.03)	3.10	0.134	23.13**

At 398 df 't' at * 0.05 level = 1.97and at ** 0.01 level = 2.59

Interpretation of Table- 4

It was evident from the Table-4 that the Motor Vehicle group (21.81) differed significantly ($p < 0.01$) in BMI than that of the Walking (21.18) and Bicycling (20.90) groups and again Walking group differed significantly ($p < 0.05$) with Bicycling group.

Similar trend was also evident in case of the % Body Fat. Motor Vehicle group (16.03) possessed significantly ($p < 0.01$) higher % Body Fat than that of the Walking (12.58) and Bicycling (12.93) groups. On the other hand, Walking group (12.58) attained significantly ($p < 0.01$) lower % Body Fat than that of the Bicycling and Motor Vehicle groups.

DISCUSSION

Due to the rising usage of cars to commute to school and the health consequences, travel mode choice among students has been extensively researched in industrialized countries (United States. Environmental Protection Agency, 2003). However, the current authors believe that different modes of transportation may have an impact on the body mass index and body fat percentage of school going children. Declining rates of functional active travel have contributed to this drop in population-level physical activity, and ecological research suggests that growing obesity levels are more pronounced in areas where active travel is declining (Pucher *et al.*, 2010; Bassett *et al.*, 2008). According to previous study, incorporating more physical activity into daily commutes independently predicts lower bodyweight and a healthier body composition in both men and women. Both active modes (walking and cycling) and public transportation had equal effect sizes and significance levels. In addition to walking and cycling, the encouragement and facilitation of increasing use of public transportation should be explored (Flint *et al.*, 2014). Alternatively, active commuting to school has been advocated as a way to boost children's physical activity while also potentially preventing or reducing excess weight gain (Sirard *et al.*, 2008). Early studies suggest that in order to enhance physical function efficiency, a good training regimen should be designed and followed (Islam *et al.*, 2020) as this would have an impact on the BMI and fat percentage of school-aged children.

The body mass index (BMI) is the ratio of a person's weight to his or her height squared. It is the most widely utilized sensitive, specific, and reliable screening tool for identifying people who may be at risk for weight-related health issues. However, according to a study, age and gender have a significant impact on BMI, so dietary practices should be adapted accordingly. Malnutrition is therefore discovered to be a significant impact in a child's development (Mahalakshmi *et al.*, 2019). Childhood obesity is on the rise, and it's been linked to a variety of disorders and death in adults, thus the body mass index (BMI) has become a popular screening tool for kids with obesity (Chung, 2015). The multiple modes of transportation define a child's healthy body shape. Obesity in youngsters is linked to being carried to school every day and having more screen time, according to researchers (Wen *et al.*, 2010).

Examining both subcutaneous and visceral fat is recommended to assess an individual's health and physical condition. It has been established that having a higher body fat mass ratio is a risk factor for cardiovascular disease (Williams *et al.*, 1992; Kutac *et al.*, 2020). Consequently, switching to physically active modes of transportation can have favourable adiposity effects, according to a longitudinal study conducted during a key life course time; these associations may be more apparent for more disadvantaged children. Inequalities can be alleviated by increasing active travel (Laverty *et al.*, 2021).

Finally, the findings of this study indicated that there were substantial differences in BMI and body fat percentage among the three modes of transportation, namely bicycling, walking, and motor vehicles. The current study confirmed that there are substantial variations in selected physiological variables among students who commute to school by walking, bicycling, or driving a car.

CONCLUSION

Based on the findings of this investigation, researchers conclude that the students who drove to school had a considerably higher BMI (21.81) and % body fat (16.03) than the other two active commuter groups, walking and bicycling. According to the present researchers, walking may be the primary mode of transportation for students who commute to school every day from their homes. The researchers also believe that walking is an excellent mode of transportation for school-going children if the school distance from home is reasonable.

FUNDING

This research received no external funding.

ACKNOWLEDGEMENT

The researchers express gratitude to the study participants.

CONFLICTS OF INTEREST

No conflicts of interest are declared by the authors.

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