Socio-economic and awareness correlates of physical activity of government school children in India

Vedanth Nandivada[1], Dr. Anjula Gurtoo[2]

[1] The International School Bangalore, Bangalore, Karnataka, India

[2] Department of Management Studies, Indian Institute of Science, Bangalore, Karnataka, India

SUMMARY

Physical activity is pivotal for development in young children. Physical activity strengthens the body at a young age, reducing chances of getting cardiovascular and other diseases later in life. Research demonstrates a significant number of adolescents worldwide do not engage in sufficient daily physical activity. This study hypothesized that socio-economic factors such as income, parental education, and demographic setting affect the amount of physical activity government-school children engage in each day. We administered a questionnaire containing 25 questions to 272 government-schooled students between the ages of 12 to 15 and found that parental follow-ups were a significant factor impacting physical activity. Children whose parents reminded them to exercise every day (n = 138) exercised on average 0.455 hours more. Girls (n = 150) on an average exercised for half an hour less than boys (n = 122) each day. Moreover, 66% of girls were unaware about the importance of exercise as compared to 52% of boys. Children who lived in urban areas (n = 140) tended to exercise for on average 0.396 more hours per day than their rural counterparts. These results highlight the need for encouraging girls and students in rural areas to exercise through indigenous games and everyday activities, such as increased use of stairs, cycling, walking, and helping with household chores. Schools and communities can play a positive role by promoting creation of environments that promote movement and exercise during the school day.

INTRODUCTION

The World Health Organization (WHO) recommends 60 minutes of moderate to vigorous physical activity (PA) a day for children aged 11 to 17 years (1). Vigorous activity is recommended at least three days a week (2). PA is deemed pivotal for development in young children for strengthening bones, muscles, hearts, and lungs at a young age and reducing the chance of cardiovascular disease, diabetes, cancer, hypertension, obesity, depression, and osteoporosis later in life (3). PA supports improved coordination, balance, posture, and flexibility as well. In addition to this, encouraging childhood PA also helps in hindering the growth of non-communicable disease related risk factors leading to adult degenerative diseases (4). Furthermore, Coe *et al.* found students that increased physical activity demonstrated

significantly higher grades in academics and standardized testing as compared to students without significant PA during these school semesters (5). In a study, PA was found to impact children's mental function positively, particularly affecting executive functioning (6). In addition, cardiovascular improvement due to PA in children is attributed to a reduction in depression and an increase in self-esteem (7).

A vast majority of children and adolescents are not engaged in sufficient exercise per day. Guthold et al. studied 1.6 million children across 146 countries and found that approximately 80% of the children between the ages of 11 and 17 were not doing adequate exercise daily (8). Tremblay et al. quantitatively graded children based on the amount of PA they did each day and found indicators of PA as either low or poor for most children (9). Globally, across income groups and regions and in nearly all countries analyzed, girls were less active than boys, and the prevalence of insufficient activity in girls has not improved since 2001 (8). India's physical activity level in adolescents was found to be quite low. The prevalence of physical inactivity among children was 21% in India with variations among different cities as per a study done in 2014 (10). A study conducted in Kullu, Himachal Pradesh found 75% of all children had a sedentary and low physically active lifestyle (11).

The amount of PA engaged in by private school children and government school children differs as well. The two types of schools demonstrate different amounts of fitness in various fitness parameters. A nationwide study conducted by Sportz Village in 2020 covering 264,681 children across 364 schools in 250 cities in India, found government-schooled children fared better in lower body strength, flexibility, aerobics, and anaerobic capacity (12). Other studies have also demonstrated that government-schooled children fare better than private-schooled children on the four components of physical fitness namely, coordination, balance, handgrip strength, and body fat percentage. Furthermore, government-schooled students perform better in tests that require speed, agility, and flexibility (13, 14). Social determinants such as where the children are born and where they live and grow have a significant impact on their amount of PA. This is evidenced in a study conducted in Western Australia. The study indicates that the social environmental determinants affect the amount of PA people engage in more than physical environmental factors (15).

Mental and physical diseases associated with lack of adequate activity are well documented in literature. Hence,

to develop effective physical activity interventions in youth, influences and determinants need to be understood. In this study, therefore, we investigate the factors influencing PA, with specific focus on the PA of government school children in India.

In this paper, we investigate the socio-economic, demographic and awareness factors influencing the amount of PA per day, of Indian school children studying in government schools. Taking support from the literature in the above paragraphs, socio-economic and demographic factors such as parental education, parental income, geographic location, and gender, were identified. Two additional factors, namely, child self-awareness of exercise and the parental follow-up for their children to exercise were added due to a gap in existing literature.

We hypothesized that socio-economic factors like parental education and parental income would have a positive correlation with the amount of exercise performed by children each day. Similarly, we hypothesized that awareness factors like the number of parental follow-ups with the children to exercise and the child's self-awareness would have positive correlation with the amount of PA performed by the children each day. We also hypothesized that boys engage in more PA than girls. We also hypothesized that students in urban settings engage in more PA than their rural counterparts. Results showed that parents who remind their children to exercise every day show the children exercising more daily. Girls on an average exercised less than boys each day. Moreover, most girls were unaware about the importance of exercise as compared to only half of the boys. Children who live in urban areas tend to exercise more hours per day than their rural counterparts

RESULTS

To measure the influence of socio-economic, demographic and awareness factors on PA, a comprehensive range of potential correlates were surveyed. A total of 25 questions were asked through an online survey to 272 children in the age range of 12–15 years across three states of India.

Demographic Analysis

We observed that 69.5% of the surveyed families had incomes less than $130 USD per month, and these parents did not study beyond grade 10 **(Table 1)**. We observed that 72.2% of the fathers and 72.7% of the mothers had education up to middle school, and 51% of the children surveyed lived in a rural environment. Regarding PA, 60% of the surveyed students were unaware of the importance of daily PA, and 17% of all boys and 36% of all girls did not engage in PA every single day as per WHO guidelines **(Table 1, Figure 1)**. Moreover, 66% of the surveyed girls were unaware about the importance of exercise as compared to 52% of boys **(Figure 2)**.
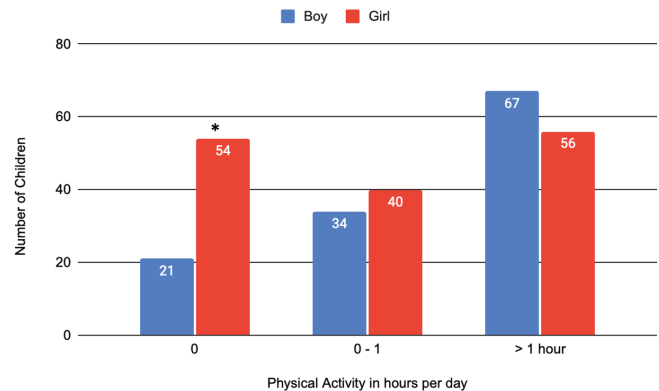
Figure 1: Distribution of children across physical activity in hours per day. Histogram displaying number of children engaging in 0, 0–1, or > 1 hour per day. Data are subset by gender into boy (blue) and girl (orange). A higher percentage of girls did not engage in physical activity and was highlighted with an asterisk.

Association Analysis

A regression analysis of the factors such as parental education, parental income, geographic location, gender, child self-awareness of exercise and the parental follow-up for their children to exercise was done using the amount of PA the children get each day as the dependent variable. The aim of the model was to understand the significant factors that are associated with the amount of daily PA **(Table 2)**. It is important to note that a positive beta value, obtained from the slope coefficient from the regression model in R, indicates a positive association where, when an increase in the independent variable leads to an increase in the dependent variable, and a decrease in the independent variable leads to a decrease in the dependent variable. Contrastingly, a negative beta value indicates that an increase in the independent variable leads to a decrease in the dependent variable and a decrease in the independent variable leads to
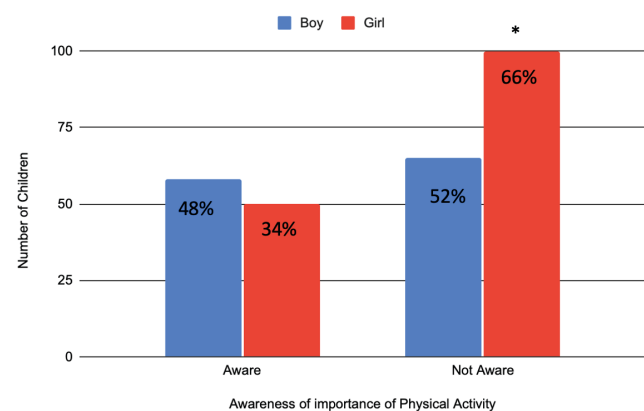
Figure 2: Distribution of children across awareness of PA. Histogram displaying number of children who are aware/unaware of the importance of daily physical activity. Data are subset by gender into boy (blue) and girl (orange). Lack of awareness of physical activity is higher among girls and was highlighted with an asterisk.

Factor	Categories of factors	Number of Children	Percentage of Children
Gender	Boy	122	44.8
	Girl	150	55.2
Family income per month	less than 10,000 INR ($130 USD)	189	69.5
	more than 10,000 INR ($130 USD)	83	30.5
Geographic Location	Rural	132	51.5
	Urban	140	48.5
Father's education	Up to Grade 10 (middle school)	197	72.4
	Up to Grade 12 (high school)	36	13.3
	Up to bachelor's degree	39	14.3
Mother's education	Up to Grade 10	195	71.7
	Up to Grade 12	44	16.2
	Up to bachelor's degree	33	12.1
Zero PA	Boys	21	28.0
	Girls	54	72.0
Time spent on PA	Children below minimum 1 hour of PA per day	147	54.0
	Children spending 1 or more hours of PA	125	46.0
Awareness of PA	Children not aware of importance of PA	163	60.0
	Children aware of importance of PA	109	40.0
Parental follow-up of PA	Children with no parental follow-up on PA	76	28.0
	Children with parental follow-up on PA	196	72.0

Table 1: Percentage distribution of various factors. Table showing the absolute value and percentage of children in various categories of the factors evaluated.

Independent Variable	Beta value	p-value
Combined parental education	-0.097	0.689
Parental play follow-up	-0.455	**0.027**
Income	-0.206	0.356
Child knowledge of exercise	-0.012	0.954
Gender	-0.583	**0.004**
Geographic Location	0.396	**0.04**

Table 2: Regression results of 6 independent variables with Physical activity as the dependent variable. Table shows the beta coefficients along with the p-values. The significant *p*-values are emboldened.

an increase in the dependent variable. It is important to note that the size of the changes of the independent variable and the dependent variable for either positive or negative beta values may not always be the same. Out of the six factors analyzed, three factors were found to significantly affect daily PA in the surveyed children ($p < 0.05$). Children who were not reminded to exercise by their parents (n = 134) engaged in on average 0.455 hours less of PA per day. Girls in the study (n = 150) on average exercised for 0.5 hours less than boys (n = 122) each day. Children who lived in rural areas (n = 140) tended to exercise for 0.396 less hours per day than their urban counterparts ($p = 0.04$). The combined education of parents ($p = 0.68$), the family income ($p = 0.35$), and the children's self-awareness ($p = 0.95$) did not appear to have a significant influence on the children's PA.

We specifically looked at whether there was a link between other daily activities of help at home, reading/studies, and

screen time (TV and phone) and PA to see whether other activities substituted the children's time spent on PA **(Table 3)**. Girls spent more time helping at home ($p = 0.05$) and reading/studying ($p = 0.004$). Rural children spent more time helping at home ($p = 0.006$), reading/studying ($p < 0.001$), and looking at screens ($p < 0.001$).

Test of Independence

Three variables namely gender, Rural vs urban location and parental follow-up associated with differences in PA, were assessed using a ChiSquare test of independence to identify correlation between the factors to understand whether multiple regression can be used. According to the Chi-Square test of independence, gender is not correlated with geographic location ($p = 0.687$) nor is parental follow-up ($p = 0.256$). However, parental follow-up and geographic location are correlated ($p = 0.008$). Child awareness, parental education, and parental income were not found to be significantly associated with the amount of PA as per the regression analysis. Parental education and income were found to be correlated ($p = 0.006$), but child awareness was not correlated with either parental income ($p = 0.597$) or education ($p = 0.082$) **(Table 4)**.

DISCUSSION

We hypothesized that socio-economic factors like parental education and parental income would have a positive correlation with the amount of exercise performed by children each day. Studies have found that the mean exercise behavior of children is higher in families with parents of higher education, indicating that parental education levels (PEL) are associated with children's PA (16, 17). In this study, we did not find enough evidence to suggest that parental education

Variable		Help at Home			Reading / Studies			Screen Time		
		Mean (hours)	t-value	p-value	Mean (hours)	t-value	p-value	Mean (hours)	t-value	p-value
Gender	Girl	2.34	1.69	**0.05**	3.11	2.63	**0.004**	3.56	0.1	0.63 -
	Boy	1.8			2.29			3.52		
Geographic Location	Rural	2.48	2.51	**0.006**	3.42	4.43	**<0.001**	4.43	4.98	**<0.001**
	Urban	1.81			2.09			2.70		
Parental Follow-up	Daily	2.36	1.99	**0.023**	3.01	2.12	**0.017**	3.96	2.83	**0.003**
	Not Daily	1.80			2.34			2.91		

Table 3: Student *t*-test results of 3 independent variables that are found to have a significant influence on physical activity. Table shows the mean, *t*-value and the *p*-value for each independent variable. The significant *p*-values are emboldened.

	Gender (Boy / Girl)	Location (Rural / Urban)	Parental Follow-up (Daily / Not Daily)	Child Awareness (Aware / Not Aware)	Family Income (<10,000 / >10,000 INR)	Combined Parent education (<25 years / >25 years)
Gender	NA	0.687	0.256	**0.017**	0.227	0.916
Rural/Urban	0.687	NA	**0.008**	**0.023**	0.068	0.733
Parental Follow-up	0.256	**0.008**	NA	**0.029**	**0.001**	0.225
Child awareness	**0.017**	**0.023**	**0.029**	NA	0.082	0.597
Income	0.227	0.068	**0.001**	0.082	NA	**0.006**
Parent education	0.916	0.733	0.225	0.597	**0.006**	NA

Table 4: Chi-square test for independence between the 6 independent explanatory variables. The table shows the *p*-values for the correlation between each variable in the matrix. The significant *p*-values are emboldened.

affects the daily PA of government-educated children in South India. One plausible reason as to why parental education is not significant in this study is that 27.8% of the fathers and 27.3% of the mothers did not complete high school. This is significantly different from the Indian average of 75% and global average of 84% completion of high school education in 2020 (18). This skew in the data may be a reason for no association effect between the two variables in the sample.

Several research studies indicated that the income of the parents of the children in India is another factor in how much PA the children engaged in daily. Children with lower family income tended to physically exert themselves less daily (19). Additionally, rural parents supported their children's PA by asking them to play using the immediate environment outside their home and by actively engaging in physical activity with their children (20). A study done in south Karnataka, India (our sample area) found children in families with higher income and wealth were more overweight and obese due to lack of PA in comparison to low-income families (21). Different studies indicated positive and negative effects of income on PA, but more analysis is needed to determine the relationship completely. Parental income was not found to be a significant factor in our study, and further research is needed to discern any effect of this variable on PA.

Our third hypothesis was that awareness factors like the number of parental follow-ups with the children to exercise would significantly affect the amount of PA performed by the children each day. Our study showed that parents who reminded their children daily to exercise saw their children exercising significantly more than those children who are not reminded daily to exercise. This relationship between the follow-ups that children engage in and PA could be because reminders are seen to increase self-efficacy to become more physically active. This may lead to behavioral changes such that the children exercise more (22). In addition to this, a study done on Asian children in India and Canada showed that family could be a facilitator of physical activity, indicating that the level of parental intervention affects whether students gain sufficient physical activity (23). Studies show parents and siblings as key sources of encouragement, modeling, facilitation, and involvement, and physical activities were viewed to strengthen these relationships with one's family (24). Further, research has found children who have high awareness of PA tend to be more physically active (25).

In addition to parental factors, children's self-awareness of the importance of PA was hypothesized to be an important factor affecting the amount of daily exercise. The regression analysis showed that children who were not aware of the importance of PA did, on average, 0.012 less hours of PA per day compared to the children who were aware of the importance of exercise. However, this difference was not significant in our study. Though in our study child self-awareness was not found to be significant, one of the factors found to influence child awareness is the physical education offered to the students in schools and the scarcity of physical education teachers in various schools (26). Additional research may be needed to assess the influence of children's self-awareness on PA.

We also hypothesized that there would be a difference between the amount of PA engaged in by boys and girls. The regression analysis indicated that on average girls physically exerted themselves for 0.583 hours less each day than boys in Indian government schools. Girls spent more time helping at home and reading/studying and hence spent less time in PA compared to boys. A study done in Himachal Pradesh, India, shows similar results with boys spending far more time on PA compared to girls (11). In a study conducted in the same area as our sample area (Southern India), girls were found to spend twice as much time completing chores, errands, and work at home, while boys spent twice as much

active time playing (27). Because of these activities, girls may not be able to make time for physical activity. Furthermore, another reason for reduced exercise in girls could be because they are seen to study 40 minutes more on average than boys. According to a study in Chennai, India, academic stress was seen to be associated with inadequate PA in adolescent girls (28). In India, historically, girls are treated significantly differently than boys in many ways. For example, girls spent twice as much active time completing chores, errands, and work compared to boys (29). Girls also faced more social censure for participating in PA (30). Additionally, according to a study done on Indian children in Canada, boys tend to play sport more for its competitive aspects whereas girls tend to play for more social reasons, such as to make new friends and have fun (31). This could also lead to different amounts of PA obtained by each gender in government schools in India.

We also explored the differences between children from rural and urban settings. Children living in urban areas exercise significantly more each day compared to those living in rural areas. Rural children spent more time helping at home, reading/studying, and looking at screens, and hence spent less time in PA compared to Urban children. There are multiple reasons why children from rural areas could exercise less than children living in urban areas. Physical education teachers are scarce in schools across rural India. According to a study done in 2018, less than 20% of all primary schools in India have a physical education teacher. In most schools where physical education teachers were lacking, another teacher (non-subject expert) was tasked with supervising physical education activities (26). Unfortunately, these teachers may not have enough experience to oversee such PA and hence the quality of the overall physical education may deteriorate.

A study in Turkey found urban children receiving less PA each day compared to their rural counterparts. The study found that 35% of the urban children were not involved in any sports activity, as compared to 30.6% of rural children. Additionally, a study from Taiwan found urban children reported greater accessibility to places for physical activity (32). This allowed the urban children to report more PA after school, on holidays and weekends, and in the total amount of PA compared with the rural children (33). A study in Mangalore, India found rural children performing better in flexibility and cardiovascular endurance tests when compared to their urban counterparts, indicating that a difference in the amounts of PA acquired by each group of students led to different athletic abilities (34). While there was no nationally representative data about school infrastructure, a study from India's 2018 report card on PA showed that most Indian schools did not have the infrastructure to support PA and infrastructure is limited to private schools that are accessible to higher socio-economic groups (35). Children from rural communities have less access to high-quality playing equipment and often, jungle gyms and playgrounds have been perceived as unsafe (25). Due to this issue, parents may be reluctant to allow their children on playing equipment, which greatly reduces the scope for their PA each day. However, in rural areas and government schools, physical education programs continued to leverage traditional indigenous games as they require limited resources and still enable PA (36).

While this study has limitations, the overall analysis indicates that factors namely parental follow-up, gender, and rural vs urban location impacted physical activity of children. The primary limitation is that the study surveyed students in limited states of India (three states of Southern India) due to accessibility. Further studies should be done taking into consideration children from different regions in India. Additionally, the pandemic severely limited our access to schools, teachers, and school children. The data was gathered through self-reported online surveys due to the pandemic. Hence, we could only capture quantitative data. Future studies should collect data through focused group discussions and interviews to obtain both qualitative as well as quantitative information. Lastly, further studies need to be done to assess other significant impact factors like teacher intervention, peer group influence, and the role of a child's psychological and future dreams on the child's physical activity. In this study, a simple linear regression model was used to assess the influence of various socio-economic and demographic factors on PA of government school children in India. As identified in the test of independence among explanatory variables, some of the socio-economic factors were correlated and hence further research on dimensionality reduction would help in identifying the accurate beta coefficients of each independent variable in a multiple regression model. Such a regression model could help in predicting the PA more accurately based on the interaction effects between socio-economic factors.

In summary, the number of parental follow-ups, geographical location, and gender played an important role in the amount of exercise a child studying in an Indian government school engaged in each day. Special emphasis can be given to bridging the gap between students in rural and urban areas. Moreover, girls and students in rural areas need to be encouraged to exercise through indigenous games and everyday activities, such as increased use of stairs, cycling, walking, and helping with household chores. Schools and communities should also play a positive role by planning environments that demand and facilitate movement (37).

MATERIALS AND METHODS
Survey and Data Collection

The survey contained 25 questions relating to the demographics of children, socio-economic factors of the parents, awareness of physical activity of the children, and distribution of time spent on various activities. The online survey was conducted from August to October 2020 on 272 students, aged 12–15 years, from Government schools across Karnataka, Andhra Pradesh, and Tamil Nadu, India. The questions asked the children for their activities between hours 08:00–12:00, 14:00–17:00, and 17:00–22:00 during

that day. Physical activity was determined as the time spent on sports and exercising, and the time spent on categories 'helping at home' and 'playing for fun' was not counted towards physical activity. Students who answered the question "How much exercise or play do you believe is needed per day" correctly on the importance of exercise were deemed to be aware of the importance of physical activity.

The type of sampling used was non-probability, convenience sampling. The sample was designed to take boys and girls across three states, with students in both rural and urban areas from grades seven to ten. The form was initially created and sent to ten children as a pilot to see whether there were any flaws in the questionnaire or if the questions were unclear. The pilot proved to be successful as a review of the pilot survey responses depicted a lack of clarity in the questions as some answers were abnormal or the questions were simply misunderstood. The insight gained from the pilot survey was used to create a revised questionnaire which changed the wording to more simplistic grammar.

Data Analyses
The data was collected using a google form, organized, and cleaned using a google sheet, and Statistical analysis was done using R. Percentage analysis was done using Google sheets **(Table 1)**. Families where the monthly income was less than 10,000 INR per month were considered to be 'low income' families in this study. Those with about 10,000 INR per month were considered to be 'high income' families.

Statistical Analyses
The dependent variable chosen was the amount of PA the children engage in each day. This dependent variable was regressed with six independent variables namely gender, parental education, parental income, parental follow-up, child's awareness of PA importance, and geographic location. Regression was conducted using a boxplot as well as the lm() function which outputs a regression table depicting the mean difference between two levels of the categorical explanatory variable as well as their respective p-values. If there were multiple levels of categorical variables, the various levels were coerced into two to meet the requirements of the lm() function. Additionally, independent sample t-tests were conducted using SPSS to find the difference in mean time spent on sports daily between those who live in rural or urban settings, the gender of the children, and the amount of screen time spent by the children to assess any reason for the results obtained by regression. Student t was used for the analysis of significant differences. Results were considered significant if p-values were < 0.05. Chi-square test was done to test for independence among the explanatory variables. Chi-square test p-values were < 0.05 when there were significant differences between the observed and expected values between variables indicating collinearity.

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Appendix:

List of Survey Questions:

1. What did you eat for breakfast yesterday or today (or in general) and how much? (If solid food, specify the number of servings; 1 Idly is 1 serving; 1 dosa is one serving; one bowl of rice is one serving. If liquid food, specify quantity in number of cups example: 2 cups of milk, 1 cup of juice etc.)

2. What did you eat for lunch yesterday or today (or in general)? Mention the quantity - 1 spoon, 2 spoons, 3 spoons for vegetables, Dal; For rice, curd, rasam and sambar mention 1 cup, 2 cups, 3 cups; For Chapathi or Egg mention 1 number, 2 number etc.

3. What did you eat for dinner yesterday or today (or in general)? Mention the quantity - 1 spoon, 2 spoons, 3 spoons for vegetables, Dal; For rice, curd, rasam and sambar mention 1 cup, 2 cups, 3 cups; For Chapathi or Egg mention 1 number, 2 number etc.

4. If you mentioned Other in the above questions, please specify

5. How many glasses of water did you consume yesterday or today (or in general per day)

6. How many times do you believe one should consume a balanced diet?

7. How much exercise or play do you believe is needed per day?

8. One boy eats 5 meals a day and out of that, two are on a balanced diet. He thinks that is good in order to be healthy. Do you agree with him?

9. What all activities did you do today or yesterday (or in general) from 8am to 12pm? Select all that apply and make sure total time adds to 4 hours.

10. What all activities did you do today/yesterday (or in general) from 2 PM to 5 PM? Select all that apply and make sure total time adds to 3 hours.

11. What all activities did you do today/yesterday (or in general) from 5 PM to 10 PM? Select all that apply and make sure total time adds to 5 hours.

12. Fathers Education

13. Mothers Education

14. How many children do you have in your family (How many brothers and sisters including you)?

15. Total monthly family income in rupees (Please check with your parents)

16. How often do your parents tell you to eat a healthy diet?

17. How often do your parents tell you to exercise/play?

18. Are you interested in joining our program to improve your health and fitness?

19. What is your medium of instruction at school?

20. What is your class or grade?

21. Your height in centimeters? (typically 125 cms to 170 cms)

22. Your weight in kilograms?

23. Gender

24. School Name, Village, City