



## Original Article

# A preliminary report on physical activity patterns among children aged 8–14 years to predict risk of cardiovascular diseases in Malwa region of Punjab

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## ABSTRACT

**Objective:** To determine the pattern of physical activity specific to age and gender among young Indian school going girls and boys aged 8–14 years.

**Design:** Cross-sectional study.

**Setting:** Private and government sponsored schools in Patiala and Mansa District of Punjab, India.

**Participants:** Two hundred thirty four school going girls and boys aged 8–14 years.

**Methodology:** A structured questionnaire recorded the various forms of daily physical activity, sedentary activity as well as physical activity level of all the participants. The energy expenditure was also calculated using the standard metabolic equivalent index.

**Results:** There is a significant difference between mean weights of participants belonging to different physical activity levels ( $p < .04$ ). In comparison to boys, the girl participants have significant lower values of physical activity duration as well as total metabolic equivalent expenditure ( $p < .05$ ). The total duration of moderate/vigorous physical activity declined in both girls and boys as the age increased.

**Conclusion:** Physical activity among children in Northern regions of India is on decline as their age increases especially among girls. It is important to determine physical activity duration in early age groups and motivate children for daily physical activity.

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## 1. Introduction

The Asian continent is said to have highest number of overweight children.<sup>1</sup> In India, between 4 and 30% of children across various regions and communities are either overweight or obese and 5% of the total Indian population is believed to be affected with morbid type of obesity.<sup>2,3</sup> The Asian Indian population is also known to have an abnormal proportion of lipid profile which is different from Western population and it further enhance the risk of various cardiovascular diseases.<sup>4</sup> The obesity has been classified as a known risk factor for diabetes mellitus type 2, raised blood pressure, abnormal lipid profile, Coronary heart disease, certain types of cancer and various other cardiovascular diseases.<sup>5,6</sup>

Physical activity has shown an inverse cross sectional relation with body fat. Researches indicate that regular physical activity reduces the amount of adipose tissue in both overweight and normal children, and in turn is linked with improved

musculoskeletal and cardiovascular system functions and enhanced intellectual performance in individuals.<sup>7,8</sup> There are several hypothesized mechanisms for the claimed positive effects of physical activity, including 1. Increased blood as well as oxygen supply to the brain and other vital organs<sup>9</sup>; 2. Increased release of nor epinephrine and endorphins hormones in the body,<sup>10</sup> and 3. Increase in growth factors that lead to formation of new nerve cells and support synaptic plasticity.<sup>11</sup> Studies indicate that children who are less physically active have higher chance of developing obesity and other cardiovascular risk factors later in their lifespan.<sup>12</sup> The physical activity has also shown its association with gender and age in children.<sup>13</sup> Specifically, The Health and Behavior of School Children (HBSC) survey conducted in 20 European countries showed that generally, boys were more active than their girl counterparts and as the age increases the time duration given to physical activity per day decreased.<sup>13</sup> A few studies conducted in India in the past have examined physical activity relation with overweight and obesity occurring in childhood. In addition the present day physical activity in young population and its relation with age gender should be checked time to time whether the variables are within recommended values to ensure optimum growth and development of children.

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Promoting physical activity in children will also motivate them to stay active during adult life and will help to reduce the burden of various chronic diseases associated with sedentary lifestyle. In the present study a survey was carried out to find association of age and gender with physical activity in Indian school children. The present study was conducted to provide evidence to ergonomic specialists to take immediate relief strategies to provide more health friendly and stress free environment to children.

## 2. Methodology

### 2.1. Participant

The present study is an observational cross sectional design. The sample size was calculated as per the sample size calculation formula given by Charan, & Biswas<sup>14</sup> Two hundred thirty four school going girls and boys, were selected randomly from private as well as government aided Schools in Patiala and Mansa districts of Punjab, India between the age group of 8–14 years (Boys N = 118; Girls N = 116) using stratified sampling method. The difference between date of birth and date of investigation was converted into decimal age with the help of decimal age calendar. The participants with the history of any congenital deformities, any medical, surgical or neurological conditions, and any recent musculoskeletal injuries were excluded from the study. The institutional ethics committee of the Department of Sports Sciences, Punjabi University, Patiala, Punjab, India approved the study protocol.

### 2.2. Anthropometric measurements

The participant's height was recorded to the nearest one-tenth of a centimeter by an anthropometric rod. During measurement the participant stood erect without footwear, took a deep breath and looked straight ahead, with heels, buttocks, thoracic spine and back of the head in contact with a vertical wall. Heels were together and arms kept sideways. The distance measured from the standing platform to the vertex was taken as subject's height.<sup>15</sup>

The body weight of all the participants was recorded to the nearest kilogram in minimal clothing with a weighing scale of 0.1 kg precision.<sup>15</sup>

Body mass index was taken as weight (in kg) divided by height (in m) squared according to Quetlet method. Total body fat percentage in body (BMI Body Fat%) was calculated using the following equation given by Deurenberg et al.<sup>16</sup>

$$\text{Child Body Fat\%} = (1.51 \times \text{BMI}) - (0.70 \times \text{Age}) - (3.6 \times \text{gender}) + 1.4$$

Units: BMI in kg/m<sup>2</sup>, Age in years, gender value for males was 1 and for females was 0 according to the equation.

### 2.3. Assessment of physical activity and sedentary activity of participants

Various forms of daily physical as well as sedentary activities of all the participants were recorded using a structured questionnaire and physical activity level of all individuals was also determined accordingly.<sup>17</sup> A questionnaire was developed specifically for the purpose of this study to note down physical activity duration during school time which included physical education classes, recess period, participation in any game during or after school hours, travel to and from school and any household activities. Duration of sleep and sedentary activities such as television or video viewing and computer games, tuitions and homework were also recorded. The energy expenditure of each physical as well as sedentary activity was calculated by the standard metabolic equivalent index.<sup>18</sup> The metabolic equivalent or MET (multiples of basal metabolic rate reflecting intensity of activity) assigned for each physical and sedentary activity was multiplied with the duration in minutes of a specific activity to obtain a composite measure of duration and intensity (MET-min) of activity.<sup>19</sup>

Physical activity level (PAL) of all the participants were calculated using Schofield equation (Estimated 24h energy expenditure divided by predicted basal metabolic rate) and previously established cut points were applied to categorize all the participants into following categories: PAL < 1.40 Nil/Fairly light physical activity lifestyle, PAL 1.40–1.69 sedentary/light physical activity lifestyle, PAL 1.70–1.99 moderate physical activity lifestyle, PAL ≥ 2.0 vigorous/heavy physical activity lifestyle.<sup>19,20</sup> The similar values had been used on Indian population earlier by research studies.<sup>21</sup>

### 2.4. Statistical analysis

The Statistical Package for Social Sciences software (V.16.0; SPSS, Inc) was used at 95% CI for statistical analysis. The Kolmogorov-Smirnov Goodness-of-Fit test verified a normal distribution of data for both boys and girls in both analyzed age groups (P ≤ .05). Mean and standard deviations were used to present the physical parameters of participants. Frequency and percentage of participants spending recommended time duration

**Table 1**

Comparison of participant variables and physical activity parameters among the different age groups of School Boys and Girls using analysis of variance.

N = 234		8–10 years	10–12 years	12–14 years	P Value
		Boy	Girl	Boy	
Height in cm	Boy	133.19 ± 9.02	141.74 ± 8.44	155.15 ± 10.93	.000
	Girl	132.73 ± 11.09	140.77 ± 11.07	150.92 ± 6.93	.000
Weight in kg	Boy	28.74 ± 6.84	31.19 ± 6.00	41.82 ± 8.73	.000
	Girl	26.59 ± 6.72	32.91 ± 7.73	39.37 ± 10.23	.000
BMI kg/m <sup>2</sup>	Boy	16.04 ± 2.62	15.80 ± 2.42	17.25 ± 2.47	.024
	Girl	15.49 ± 3.13	16.44 ± 2.38	16.99 ± 3.58	.099
BMI Body Fat percentage (%)	Boy	15.32 ± 3.95	13.53 ± 3.67	14.41 ± 3.70	.116
	Girl	17.25 ± 3.61	17.73 ± 3.55	17.96 ± 5.28	.750
Total Sedentary activity duration (Hours)	Boy	11.26 ± 2.00	11.61 ± 2.15	11.47 ± 1.92	.749
	Girl	11.53 ± 1.03	12.40 ± 2.02	11.73 ± 1.74	.046
Total Sedentary activity (MET-Hour)	Boy	691.29 ± 148.01	728.08 ± 157.29	706.98 ± 140.83	.550
	Girl	698.13 ± 78.98	795.97 ± 160.13	753.97 ± 195.85	.022
Moderate/Vigorous Physical Activity Duration (Hours)	Boy	2.19 ± 0.90	2.02 ± 1.02	1.90 ± 0.92	.426
	Girl	1.91 ± 1.00	1.73 ± 0.92	1.06 ± 0.73	.000
Moderate/Vigorous Physical Activity energy expenditure (MET- Hour)	Boy	932.13 ± 426.42	927.60 ± 466.99	869.13 ± 482.85	.438
	Girl	848.71 ± 454.97	794.08 ± 409.35	478.99 ± 344.97	.000

The Data is represented as mean and standard deviation.

of daily physical activity were also computed. Analysis of variance (ANOVA) and Scheffe Post-hoc analysis were done to compare various variables among age groups at 95% Confidence Interval.

### 3. Results

A total of 250 children were recruited for the study and after screening for inclusion and exclusion criteria, 234 were selected to participate in present study. The mean age of boy and girl participants was  $11.81 \pm 1.54$  years and  $11.30 \pm 1.66$  years, respectively. In boy participants the mean body mass index was  $16.37 \pm 2.57 \text{ kg/m}^2$  with mean height  $143.53 \pm 13.09 \text{ cm}$  and mean weight  $34.01 \pm 9.21 \text{ kg}$  while in girl participants mean body mass index was  $16.32 \pm 3.10 \text{ kg/m}^2$  with mean height  $141.62 \pm 12.23 \text{ cm}$  and mean weight of  $33.01 \pm 9.81 \text{ kg}$ . Both the boy and girl participants were separately divided into three groups according to their age classified as late childhood (8–10 years), pre-pubescent period (10–12 years) and pubescent period (puberty) (12–14 years) for the purpose of data interpretation.

In Table 1, the comparison between height, weight and BMI among different age groups revealed a significant difference ( $p < .05$ ) except BMI values in girl participants. Total sedentary activity duration in hours, total sedentary activity (MET-hour), moderate/vigorous physical activity duration (hours), moderate/vigorous physical activity energy expenditure (MET-hour) values revealed a significant difference ( $p < .05$ ) in girl participants while BMI body fat percentage in different age groups among both girls and boys revealed a non significant difference ( $p > .05$ ). Scheffe's post hoc analysis showed significant difference ( $p < .05$ ) in terms of height (in cm) and weight (in kg).

Table 2 represents the comparison of mean Weight (in kg) and mean Height (in cm) study values of participants ( $N = 234$ ) aged of 8–14 years with norm values given by the Indian Academy of Pediatrics Growth chart committee (IAP, 2015).<sup>22</sup> High percentage difference was found between mean weight and height study values and norm values given by IAP, 2015, in both boys and girls. The study values were lower than norm values.

In Table 3, there was a significant difference between mean weights of participants belonging to different physical activity levels ( $p < .04$ ). There was no significant difference of BMI and BMI Bdy Fat% of participants belonging to different physical activity level.

In Table 4, the comparison between girl and boy participants physical activity revealed a significant difference. The total sedentary activity per day and total sedentary activity (MET-Hour)

was higher in girl participants while moderate/vigorous physical activity duration (minutes) and moderate/vigorous physical activity energy expenditure (MET-hour) was higher in boy participants.

Table 5 represents the comparison of daily physical activity (moderate to vigorous) of school children between the age group of 8–14 years with recommended values ( $N = 234$ ). The respective frequency and percentage of school children having recommended moderate-vigorous Physical activity per day (norm values  $\geq 1 \text{ h}$ ) was 122 and 52.7% only.

### 4. Discussion

In the present study the association among weight, BMI, BMI Body fat% and physical activity of young school going Indian girl and boy participants was determined. The main purpose of this study was to determine the pattern of physical activity specific to age and gender among young Indian school going girls and boys aged 8–14 years.

#### 4.1. Physical characteristics of participants and comparison with norm values given by IAP (2015)

In Table 1, the comparison between variables (Height, Weight, BMI and BMI Body Fat%) among different age groups revealed a significant difference ( $p < .01$ ) in both boy and girl participants except BMI in girl participants and BMI Body Fat% in both participants. Therefore the influence of age on these variables cannot be neglected in interpretation of further results. Since the F ratio is significant for all these variables the scheffe's Post Hoc analysis was also computed. Both weight (kg) and height (m) increased significantly in each higher age group. In both boy and girl participants the duration and MET expenditure of sedentary activity was highest in the age group of 10–12 years and was lowest in the age group of 8–10 years. Although the differences of both duration and MET expenditure in sedentary activity was not significantly high in both boy and girl participants belonging to various age groups. In case of physical activity duration and MET expenditure, in both boy and girl participants it was highest in the age group of 8–10 years and was lowest in the age group of 12–14 years. In comparison to boy participants the girl participants had lower values of physical activity duration as well as total MET expenditure during physical activity in all age groups.

In Table 2, the comparison of mean Weight (in kg) and mean Height (in cm) study values of boy and girl subjects ( $N = 234$ ) aged

**Table 2**  
Comparison of Mean Weight (kg) and Height (cm) study values of Boy and Girl participants aged 8–14 years with norm values by (IAP, 2015) ( $N = 234$ ).

Age in years	Gender (n)	Weight (KG)			Height (CM)		
		Study values <sup>a</sup>	Norm values	% diff. <sup>b</sup>	Study values <sup>a</sup>	Norm values	% diff.
8	Boy (10)	23.5	24.8	5.24	125	126.4	1.1
	Girl (11)	22.8	24	5	122	125.4	2.71
9	Boy (12)	25.7	27.9	7.89	130.5	131.8	0.99
	Girl (12)	27	27.2	0.74	134.4	131.4	2.28
10	Boy (16)	28.8	31.1	7.4	131.8	137.2	3.94
	Girl (15)	27.1	31	12.58	131.6	137.4	4.22
11	Boy (20)	31.5	34.7	9.22	142.4	142.7	0.21
	Girl (16)	33.4	35.4	5.65	138	143.3	3.7
12	Boy (20)	28.8	39	29.82	138.6	148.4	0.63
	Girl (23)	36.4	39.8	8.54	147	148.4	0.94
13	Boy (21)	40.6	43.3	6.24	153.5	154.3	0.52
	Girl (19)	39.6	43.6	9.17	150.3	152.2	1.25
14	Boy (19)	39.7	48.2	17.63	151.3	159.9	5.38
	Girl (20)	34.5	46.4	25.65	149.1	154.7	3.62

<sup>a</sup> Study values represent only mean values as mean norm values (IAP growth charts, 2015) only are available.

<sup>b</sup> % diff. was calculated as  $((\text{Norm value} - \text{Study value}) \div \text{Norm value}) \times 100$ .

**Table 3**  
Comparison of body composition of girls and boys belonging to different physical activity level.

N = 234	Nil N = 8	Fairly Light N = 38	Light N = 84	Moderate N = 58	Heavy N = 46	P value
Weight (kg)	36.02 ± 12.78	37.71 ± 9.68	32.57 ± 9.04	32.60 ± 8.98	32.47 ± 9.62	.041
BMI (kg/m <sup>2</sup> )	17.49 ± 3.46	16.69 ± 2.95	15.94 ± 2.77	16.46 ± 2.90	16.45 ± 2.71	.449
BMI Body Fat %	19.05 ± 5.69	16.44 ± 4.74	15.72 ± 4.36	15.69 ± 4.03	16.06 ± 3.91	.283

The Data is represented as mean and standard deviation.

**Table 4**  
Comparison of Mean value of physical activity and sedentary activity among Boys and Girls between age group of 8–14 years N = 234.

Age group 8–14 years	Boy N = 118	Girl N = 116	P value
Total Sedentary activity duration (Minutes)	686.86 ± 120.97	712.11 ± 100.90	.085
Total Sedentary activity (MET-Hour)	709.08 ± 148.37	749.80 ± 157.37	.043
Moderate/Vigorous Physical Activity Duration (Minutes)	122.08 ± 57.03	93.73 ± 57.24	.000
Moderate/Vigorous Physical Activity energy expenditure (MET- Hour)	932.14 ± 459.26	706.04 ± 433.74	.000

**Table 5**  
Frequency and Percentage of school children between the age group of 8–14 years having recommended moderate–vigorous Physical activity per day (norm values ≥ 1 h).

Age in years	Gender (N)	Frequency and% of school children having ≥ 1 hour (Moderate to vigorous) Physical activity per day; Values <sup>a</sup>
8–14	234	Total = 107 (45.72)
8	Boy (10)	6 (60)
	Girl (11)	9 (81.8)
9	Boy (12)	6 (50)
	Girl (12)	9 (75)
10	Boy (16)	11 (68.7)
	Girl (15)	7 (46.7)
11	Boy (20)	11 (55)
	Girl (16)	5 (31.3)
12	Boy (20)	8 (40)
	Girl (23)	7 (30.4)
13	Boy (21)	11 (52.3)
	Girl (19)	4 (21.1)
14	Boy (19)	10 (52.7)
	Girl (20)	3 (15)

<sup>a</sup> Study values represent frequency and percentage (in brackets).

8–14 years with norm values given by the Indian Academy of Pediatrics Growth chart committee (IAP, 2015)<sup>22</sup> revealed a high percentage difference. The study values were found to be lower than norm values. In the absence of any obvious medical or surgical history the loss of weight and height in children could be due to energy imbalance or improper nutrition. Energy balance is helpful in maintaining ideal body weight specific to age and gender. Reaching and maintaining healthy weight is important for attaining optimum health status. It also prevents and controls various kinds of diseases and conditions.<sup>22</sup>

#### 4.2. Physical activity and BMI body fat percentage of participants

We had initiated the study to analyze the pattern of physical activity specific to age group 8–14 years and gender and its association with BMI body fat percentage of participants. There was a significant difference between mean weights of participants belonging to different physical activity levels ( $p < .04$ ) (Table 3). The increased body fat in young individuals is considered as a known risk factor for developing several cardiovascular diseases later in adult life.<sup>15</sup> In present study there was no significant difference of BMI and BMI body fat% of participants belonging to different physical activity level (Table 3). Hence body composition was not considered as a determinant of physical activity patterns among children aged 8–14 years. Although in this study there was no significant difference between mean BMI and BMI body fat% of

participants belonging to different categories of Physical activity. However the mean weight, BMI and BMI body fat% was lower among participants reporting heavy physical activity as compare to those having Nil Physical activity (Table 3).

#### 4.3. Physical activity pattern specific to age and gender and predictors of physical activity

There is scarcity of literature present over physical and sedentary activity patterns of school children in India. Previous researches have indicated that there is decreased physical activity and increased sedentary activity levels in children lead to many chronic diseases in adulthood. Hence promoting physical activity in young age may reduce the risk factors of various chronic diseases of adult age.<sup>12</sup>

In the present study the patterns of physical as well as sedentary activity of school children between the age group of 8–14 years were assessed using an interview based questionnaire and the difference between physical and sedentary activity of boys and girls of different age groups were also examined.<sup>17</sup> The Sedentary activities like sleep, watching television or videos, computer games, tuitions, homework and passive games are the activities with MET levels below 1.5 while Moderate-to-vigorous physical activity (MVPA) like activities in school during physical education classes and recess periods, participation in games before or after school hours, travel to and from school and



household activities etc are with a MET cut-off value of 3 or above.<sup>23,24</sup>

In boy participants the duration and MET expenditure of Sedentary Activity had no significant difference among different age groups while a significant difference was found among girl participants and the duration and MET expenditure of sedentary activity was highest in the age group of 10–12 years. In case of physical activity duration and met expenditure in both boy and girl participants the duration and MET expenditure of physical activity was highest in the age group of 8–10 years and lowest in the age group of 12–14 years. In comparison to boy participants the girl participants had lower values of physical activity duration and total MET expenditure during physical activity in all the age groups (Table 4). The gender differences in children were evident in all the age groups from 8 to 14 years. Previous studies in developed countries have also reported the similar results of differences in physical and sedentary activity patterns with age, gender and body composition in children. Gender has been a consistent factor in influencing the physical activity patterns. Girls exhibit greater inclination towards lesser physical activity as compare to boy counterparts. According to past studies other than age and gender, previous physical activity and self-efficacy had also been associated with change in physical activity. However the past literature had found no association of value of health, appearance and achievement, anthropometry, ethnicity, parental marital status, parental support, smoking, barriers to physical activity, parental physical activity and attitudes and parental role modeling with change in physical activity. A survey study conducted in several European nations indicated that boys spent more time in physical activity as compare to their girl counterparts and also as the age increases the amount of time spent in physical activity per day decreases and sedentary activities duration per day increases.<sup>13,25</sup> The results of this study confirmed some, but not all, of the previously established correlates of physical activity within the age group of 8–14 years.<sup>26</sup> Hence age, gender, previous physical activity and self efficacy can be considered among the primary predictors of physical activity patterns among children while all other factors can be classified as indeterminate associations. Providing recess hour in schools is a good option to promote physical activity duration in school children.

Only 45.72% of our participants reported that they had indulged in recommended 1 h or more of moderate- vigorous intensity physical activities for most days of a week at least for 1 year already (Table 5). Similar results were also found in the studies of Swaminathan et al, in which fewer participants reported of having regular physical activity within recommended values.<sup>17</sup>

Clements et al in their study found that children in USA today had considerably lesser time spend in daily physical activity than their mothers did as children. The study also reported the frequent use of electronic devices as a main diversion from playing outdoors among children and that interest should be cultivated in children for outdoor play from early childhood periods.<sup>27</sup> Godbey et al in his study defined the research literature on relation of human health with outdoor recreation. It stated that being outside in natural surroundings may improve health and in terms benefit the participants.<sup>28</sup>

Several strategies can help to induce physical activity among school children during school hours. Studies have promoted the benefit of Evidence-based recess regulations like providing safe environment, recreational equipments, playground markings and trained supervisors. Partnering with local businesses or civic organizations for donations, and getting incentives from government agencies can help to create an optimal environment for promoting physical activity in school children during recess hour.

Our study has limitation of not including daily dietary intake of participants which may influence their body weight, BMI and Body

fat% readings. Our study is also limited by the fact that certain anthropometric measurements like waist circumference of participants were not included in the present study which is considered as an effective clinical predictor of metabolic risk comparable with clinical, biochemical and other imaging modalities.

The studies carried out in different parts of world also indicate that today children spend lesser time playing outdoors. Overall the results of our study indicate that physical activity among children is on decline as the age increases and moreover girls have even lesser daily duration of physical activity as compare to their boy counterparts. Both age and gender are considered to have significant influence on physical activity patterns. Lesser physical activity than recommended values enhances the risk of developing cardiovascular diseases. Hence young individuals should be motivated to carry out daily regular physical activities as recommended early in their lives.

## 5. Conclusion

Physical activity among children in Northern regions of India is on decline as the age increases and is even lesser in girls as compare to their boy counterparts. It is important to determine physical activity in early age groups and motivate children for daily physical activity.

## Competing interests

None.

## Ethics approval

Institutional ethics committee of Department of Sports Sciences, Punjabi university, Patiala, Punjab, India.

## Contributors

Vandana Esht contributed to data collection, data analysis and manuscript writing and made the final decision regarding the manuscript; Divya Midha contributed to manuscript writing, Subhashish Chatteerjee contributed to manuscript writing, Sorabh Sharma contributed to manuscript writing.

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