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A Study of Physical Activity Levels and Its Impact on Body Mass Index (BMI) of 8-10 Years Old School Going Children in Mumbai

Shikha Dwivedi[1*] and Rupali Sengupta[1]

[1]Department of Clinical Nutrition and Dietetics, Dr. BMN College of Home Science (Affiliated to SNDT University) 338, Rafi Ahmed Kidwai Marg, Matunga, Mumbai-400019, India.

Authors' contributions

This work was carried out in collaboration between both authors. Author RS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author SD managed the analyses of the study. Author SD managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Introduction: Regular physical activity in childhood and adolescence is important for promoting lifelong health and well-being and preventing various health conditions. The 2008, Physical Activity Guidelines for Americans recommended that children and adolescents aged 6 to 17 years should have 60 minutes (1 hour) or more of moderate and vigorous intensity physical activity each day. Unfortunately, many children and adolescents do not meet the recommendations set forth by the guidelines.
Aim: To study the physical activity levels and its impact on body mass index (BMI).
Methodology: 420 subjects were selected by purposive random sampling method from 5 schools of Mumbai. Physical activity levels of the samples were assessed through the physical activity questionnaire and the height and weight of all the samples were taken to calculate the BMI.
Results: It was observed that 39.5% performed sedentary activities for on an average of 0-1

**Corresponding author: Email: dwivedishikha3195@gmail.com;*

hr/week. Similarly, 74.2% subjects performed moderate to high intensity activities for an average of 0-1 hr/week. Maximum % of subjects (48%) spent 1-2hr/week in performing sedentary activities whereas, when compared to moderate to high intensity activities maximum % of subjects performed only for 0-1 hr/week. Only 116 subjects met the daily requirements of moderate to high intensity physical activity. A total of 33.2% of samples were observed to be under the three categories of wasting (mild, moderate and severe respectively) as per WHO standards.

Keywords: Physical activity; BMI; wasting (low weight for height/ malnourished).

1. INTRODUCTION

1.1 What is Physical Activity?

According to WHO physical activity is any bodily movement produced by skeletal muscles that requires energy expenditure – including activities undertaken while working, playing, carrying out household chores, travelling, and engaging in recreational pursuits. The term "physical activity" should not be confused with "exercise", which is a subcategory of physical activity that is planned, structured, repetitive, and aims to improve or maintain one or more components of physical fitness. Beyond exercise, any other physical activity that is done during leisure time, for transport to get to and from places, or as part of a person's work, has a health benefit. Further, both moderate- and vigorous-intensity physical activity improve health [1].

1.2 How Much of Physical Activity is Recommended?

WHO recommended that 5-17 years children and adolescents should do at least 60 minutes of moderate to vigorous-intensity physical activity daily as physical activity of amounts greater than 60 minutes daily would provide additional health benefits [1].

1.3 Benefits of Physical Activity and Risk of Insufficient Physical Activity

According to WHO regular physical activity of moderate intensity – such as walking, cycling, or doing sports – Showed significant benefits for health. At all ages, the benefits of being physically active outweigh potential harm, for example through accidents. Some physical activity was better than doing none. Thus, respondents become more active throughout the day in relatively simple ways, people can quite easily achieve the recommended activity levels [1].

As mentioned by WHO regular and adequate levels of physical activity: Improved muscular and cardiorespiratory fitness; Improved bone and functional health; Resulted into reduction in hypertension, coronary heart disease, stroke, diabetes, various types of cancer (including breast cancer and colon cancer), and depression; Also, decline in the risk of falls as well as hip or vertebral fractures were noted; These components are fundamental to energy balance and weight control.

Insufficient physical activity is one of the leading risk factors for global mortality and is on the rise in many countries, adding to the burden of NCDs and affecting general health worldwide. People who are insufficiently active showed a 20% to 30% increased risk of death compared to people who were sufficiently active.

According to the National Physical Activity Plan,2014 routine physical activity, among all ages, was not just about exercising to improve outward appearance. In addition to reducing body mass index (BMI) and body fat, habitual physical activity was found to be associated with improvement across many health outcomes, which might not be apparent to most individuals.

A meta-analysis of 15 original studies involving randomized and nonrandomized trials with 13,003 children found a lack of favourable BMI outcomes for physical activity-based school interventions. In this meta-analysis, the weighted average difference between groups was 0.05 kg/m2 (95% CI: −0.19 to 0.10). In contrast, another meta-analysis that was reviewed, showed a randomized and nonrandomized trials and included interventions based on physical activity along with nutritional counselling showed beneficial effects on the control of childhood obesity based on BMI measurement. This type of intervention was particularly effective for programs aimed at children aged 6-12 years. For this age group, the weighted average difference between groups was −0.15 kg/m2 (95% CI: −0.21, −0.09). However, the data revealed high heterogeneity (I2 =82%) [2].

2. MATERIALS AND METHODS

2.1 Sampling

The study was conducted in Mumbai city, Maharashtra, India.

Due to the diverse economic and cultural background and convenience of the researcher Mumbai city was selected, it provided an ideal setting to study the physical activity levels and its impact on BMI of school going children. The study was carried out between November 2018 to March 2019.

5 schools, ranging from public to private schools were selected from Mumbai city, by purposive random sampling.

2.2 Target Group Selection

Samples falling under the age group of ≥ 8 years from 3rd grade from the 5 selected schools were selected by random, purposive sampling.

2.3 Study Design

Anthropometric measurements were collected by using InBody 620 and GPM anthropometric standardised instrument kit.

Questionnaire based data was collected from the concerned parents/guardians based on parameters like physical activity patterns.

The samples comprised of students from all 5 schools of both sexes.

2.4 Sampling Technique

Random purposive sampling technique was employed for the samples.

2.5 Sampling Tools

The body composition analyzer (InBody 120 machine from InBody India)

The body composition analyzer machine was used for collecting the body composition data. Body composition analysis gives basic information of the subject's physical status and gives accurate results. The machine analyses different parameters like weight, height, BMI, total body water, protein, total fat percentage, total body fat, visceral fat levels, and lean muscle mass and skeletal muscle mass. The subjects were guided to stand on the inbody120 machine and the results sheet of the subject was recorded. The measurements were taken within less than 30 seconds for each child.

2.6 Stadiometer

Stadiometer are used in routine medical examination and also for the clinical tests and experiments. It is usually constructed out a ruler and a sliding horizontal headpiece which is adjusted to rest on the top of the head. The horizontal arm was adjusted on the stadiometer so that it is resting on the top of the head. The subjects were placed in front of the stadiometer with bare foot because shoes, slippers, socks can affect the measurements even caps, hats were not allowed to wear for the measurement. The stadiometer was placed near a wall so that the children should stand parallel of the stadiometer. The subjects were guided to stand with their back, shoulder and head straight to the wall with chin straight forward and the horizontal arm was adjusted it correctly to take the measurements. The height of the subjects was displaced on the vertical pole by an arrow pointed to the measurements at the base of the horizontal arm.

2.7 Anthro Plus

The Anthro Plus app from WHO [3] was used to calculate the Z score of BMI for age and the categories were as follows:

BMI codes	Z score	BMI category
1	1 TO 2 SD	Normal
2	2.1 TO 3 SD	Overweight
3	ABOVE 3SD	Obese
4	-2.0 TO -1 SD	Mildly wasted
5	-3 TO -2 SD	Moderately wasted
6	ABOVE -3 SD	Severely wasted

Sample Size: 420

Inclusion Criteria:

Students from 3rd grade from the 5 selected schools, Gender- Male and Female

Exclusion Criteria:

1. Subjects with any physical disability were excluded as they did not fall under the criteria for usage of the machine.
2. Subjects with any form of implant and pacemaker were also excluded

3. RESULTS AND DISSCUSSION

Table 1 describes the % distribution of subjects according to BMI cut-offs of WHO Guidelines (2007). Accordingly, it showed that maximum number of subjects (64.3%) were under the normal category of BMI as compared to 15.1% subjects were under the category of mildly wasted and only 6.5% were observed to be moderately wasted. Further, it was noted that 11.6% of subjects were severely wasted. Subjects who were classified under the overweight and obese category were 2.3% and 0.2% respectively. Hence the above table depicts that according to the BMI there was prevalence of wasting among the samples in the study.

Regular physical activity in childhood and adolescence is important for promoting lifelong health and well-being and preventing various health conditions. The 2008, Physical Activity Guidelines for Americans recommend that children and adolescents aged 6 to 17 years should have 60 minutes (1 hour) or more of moderate and vigorous intensity physical activity each day. Unfortunately, many children and adolescents do not meet the recommendations set forth by the guidelines.

Table 2 describes the % distribution of subjects according to average time spent in sedentary activities such as tuitions, chess, carrom, computer and music as well as average time spent for moderate to high intensity activities such as football, basketball, badminton, swimming, skating, cricket, cycling, khokho, kabaddi, yoga, martial arts, dance, and games like hide and seek in hr/week. It was observed that 39.5% performed sedentary activities for on an average of 0-1 hr/week. Similarly, 74.2% subjects performed moderate to high intensity activities for an average of 0-1 hr/week. Maximum % of subjects (48%) spent 1-2hr/week in performing sedentary activities whereas, when compared to moderate to high intensity activities maximum % of subjects performed only for 0-1 hr/week. The above comparison hence showed that subjects spent relatively lesser time performing moderate to high intensity activities and more time in performing sedentary activities which may be an important factor in inappropriate growth of the subjects physically.

Table 3 describes the correlation of average time spent for moderate to high intensity activities such as basketball, football, yoga, gymnastics, badminton, cricket, cycling, martial arts, dance, swimming etc. with the BMI standards of WHO (2007). It was observed that out of total 304 subjects conducted under the study performing an average of <60min/week of moderate to high intensity activity 49 subjects were reported to be mildly wasted followed by 24 subjects were moderately wasted, as compared 29 subjects were observed to be under severely wasted category. Similarly, it was noted that 15 subjects out of 116 performed an average of >60mins/week of moderate to high intensity activity belonged to the mildly wasted category, followed by marginal number were under moderately wasted and only 18 subjects were severely wasted category. Further, it was noted that out of the 304 subjects performing an average of < 60 mins/week of moderate to high intensity activities only 6 and 1 subjects were reported to be overweight and obese respectively. Similarly, for subjects performing an average of >60mins/week of moderate to high intensity activity showed similar effects as above for overweight and obese category. However, subjects under the category of normal performing an average of <60mins/week of activity represented an exponential increase by 195 samples of 304 as compared to average of >60min/week of activities were found to be 77 of 116 subjects. Hence, it was reported that subjects performing <60mins/week on an average for moderate to high intensity activities

Table 1. Percentage distribution of subjects according to BMI for age Cut-offs

BMI codes	Z score	BMI category	Percent of samples under different category (%)
1	1 TO 2 SD	Normal	64.3
2	2.1 TO 3 SD	Overweight	2.3
3	ABOVE 3SD	Obese	0.2
4	-2.0 TO -1 SD	Mildly wasted	15.1
5	-3 TO -2 SD	Moderately wasted	6.5
6	ABOVE -3 SD	Severely wasted	11.6
Total			100.0

Table 2. Percentage distribution of subjects according to average time spent in doing sedentary and moderate to high intensity activity in hr/week

Average time in spent in doing sedentary and moderate to high intensity activity in hr/week	% of subjects doing sedentary activity	% of subjects doing moderate to high intensity activity
0-1 hr	39.5	74.2
1-2 hr	48	20.2
2-3 hr	10.7	4
3-4 hr	0.8	1.5
4-5 hr	0.2	0.6
5-6 hr	0.2	0.4
Total	100.0	100.0

Table 3. Correlation of average time spent in moderate to high intensity activity with BMI

Average moderate to high intensity activity in Mins/week	BMI cutoffs*						Total	Sig.
	1	2	3	4	5	6		
<60min/wk	195	6	1	49	24	29	304	
%	46.4	1.4	0.2	11.7	5.7	6.9	72.4	
>60min/wk	77	3	0	15	3	18	116	**.185**
%	18.3	0.7	0	3.6	0.7	4.3	27.6	
Total	272	9	1	64	27	47	420	
%	64.8	2.1	0.2	15.2	6.4	11.2	100.0	

**BMI Cut-offs: 1= Normal, 2= Overweight, 3= Obese, 4= Mildly wasted, 5= Moderately wasted, 6= Severely wasted*

Table 4. Effect of total METS/mins/week on BMI

BMI codes	Category	No of subjects	Total METS/MIN/Week for light activity $\bar{x}\pm\sigma$	Total METS/MIN/ week for moderate activity $\bar{x}\pm\sigma$	Total METS/MIN/week for vigorous activity $\bar{x}\pm\sigma$
1	Normal	277	698.42 ± 495.93	1386.88 ± 1994.57	132.94 ± 432.68
2	Overweight	10	744.60 ± 462.78	1255.20 ± 804.16	295.50 ± 519.52
3	Obese	1	1122.0	600.0	00
4	Midly wasted	65	769.97 ± 440.39	1152.75± 1387.50	103.38 ± 474.28
5	Moderately wasted	28	644.93 ± 481.89	667.14± 840.38	29.46 ± 108.35
6	Severely wasted	50	684.32 ± 408.87	1694.04 ± 1598.82	14.04 ± 75.27
Total		431	706.16 ± 475.64	1335.57±1800.39	111.47 ± 404.15
Sig.			**.757**	**.226**	**.221**

had maximum number of subjects in the category of mild to severely wasted and even overweight and obese than subjects who spent >60 mins/week on an average for the same activity. The average time spent for moderate to high intensity activities was however, not reported to be significantly correlated with BMI at P > 0.05 (.185).

The physiologic effect of physical activity is that it expends energy. A metabolic equivalent, or MET, is a unit useful for describing the energy expenditure of a specific activity. A MET is the ratio of the rate of energy expended during an activity to the rate of energy expended at rest. For example, 1 MET is the rate of energy expenditure while at rest. A 4 MET activity

expends 4 times the energy used by the body at rest. If a person does a 4 MET activity for 30 minutes, he or she has done 4 x 30 = 120 MET-minutes (or 2.0 MET-hours) of physical activity. A person could also achieve 120 MET-minutes by doing an 8 MET activity for 15 minutes [4].

Table 4 describes the correlation of the total Mets/mins/week of light (<3.0METS/min), moderate (3.0-5.9 METS/min) and vigorous activity (>6.0METS/min) on BMI, it was observed that the mean value for total Mets/min/week for light activities was found to be 698.42 ± 495.93, for moderate activities 1386.88 ± 1994.57 and for vigorous activities 132.94 ± 432.68 respectively. Eventually all the samples were found to be under the normal category of BMI in the study. Alternatively, it was noted that negligible subject were under the category of obese when correlated with the total Mets/min/week for light activities had highest mean value. Further, the mean value of total Mets/min/week for light activities was found to be 769.97± 440.39 followed by 1152.75 ± 1387.50 for moderate activities and 103.38 ± 474.28 for vigorous activities, for the subjects who were mildly wasted. Similarly, subjects under the category of severely wasted were reported to have the mean value for total Mets/min/week of 684.32± 408.87 for light activities followed by 1694.04±1598.82 for moderate activities and 14.04±75.27 for vigorous activities. However, the mean for total Mets/min/week for light activities was found to be 644.93± 481.89, followed by 667.14 ± 840.38 for moderate activities and 29.46± 108.35 for vigorous activities for subjects who were under the category of moderately wasted. Further, it was noted that the total Mets/min/week for light, moderate and vigorous activities was not significantly correlated with the BMI of the subjects since $P > 0.05$ in the study.

4. CONCLUSION

The present study was conducted in five schools in Mumbai. Purposive random sampling was done and students of class 3 were considered as the samples for the study. The data was collected for the assessment of physical activity levels and to study its effect on z score of BMI for age. Physical activity questionnaires were used for the assessment and InBody 120 machine (InBody India) was used for assessing the BMI of the subjects. The results revealed that maximum % (64.3) of subjects were under the normal category of BMI, minimal % of subjects were overweight and obese (2.3 and 0.2 respectively) followed by higher prevalence of wasting was observed and were categorised as mildly wasted (15.1%), moderately wasted (6.5%) and severely wasted (11.6%) in the study. It was also observed that subjects spent more time performing sedentary activities and only minimum % (27.6) of subjects met the daily requirement of performing moderate to high intensity activity i.e. on an average of ≥60mins/week. However, it was also noted that subjects who employed lesser time in moderate to high intensity activity had higher prevalence of wasting. Hence, an attempt should be made to enhance the overall quality of life of the samples through improving the physical activity levels and dietary patterns which be beneficial in improving the body composition status.

5. LIMITATIONS

1. Anthropometric measurements could have been done more precisely to validate the data statistically.
2. Other aspects of physical activity could have been covered like walking to school, usage of stairs etc.

6. RECOMMENDATIONS

1. Can be studied on other age groups
2. The physical activity levels and BMI for age could be compared according to gender and socioeconomic status.

CONSENT AND ETHICAL APPROVAL

I would like to address that the ethical approval has been done, even the written consent of students and their parents has been taken before taking the data.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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