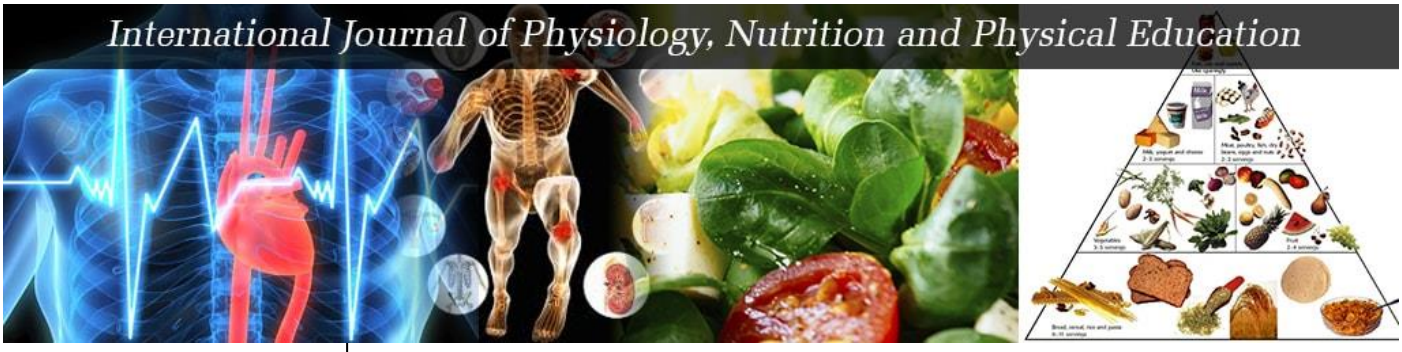

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Physical activity patterns and sleep patterns among school going children of age 10-12 years across Mumbai

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Abstract
Aim: The main aim of the study was to assess the duration, frequency and intensity of the physical activity and understand the factors affecting it as well as sleep patterns in 10-12-year-old children in Mumbai, India
Methodology: A cross sectional study conducted in 5 schools across Mumbai suburbs. The children were given a self- reported questionnaire to be filled and their anthropometric measurements were taken.
Data collection and statistical analysis: Data was collected over a period of 4 months in a sample size of 300 students and SPSS software was used for analysis. Data are presented as Mean ± SD, median (minimum-maximum) or percentage.
Results: A positive correlation was observed between familial support and physical activity as well as between the peer support and physical activity (p value<0.005). 60% of the population claimed to engage in more of sedentary activities on a daily basis. About 40% of the population reported sleeping less than 5 hours a day. Students of the private schools had higher physical activity time as compared to the government schools, in spite of the obesity ratio being higher in private schools. When MET values via questionnaires were compared to MET values from the pedometer readings, a positive correlation was observed between them which suggested that the pedometer readings coincided to the self-reported questionnaire and that the children reported correct measures of activity (p value <0.001).
Conclusion: The study suggests that more number of children should be engaged in physical activity and the duration should increase. Also, parental and peer support has a greater influence on improving the physical activity of a child.

Keywords: Physical activity, MET, adolescent, school children, screen time, activity patterns

Introduction
With the increment and advancement of technology as well as sedentary lifestyle, physical inactivity has become a subject of concern. Although, physical activity has received much acknowledgement in the recent years, the response is underwhelming. The benefits of being physically active has been around for quite some years now, however, despite of knowing the benefits and its ability to reduce the risks of developing NCDs, 80% of the world's population is still physically inactive (as suggested by the WHO 2016 reports) [1]. Looking at the physical inactivity, >80% school going population of South-east Asia itself is inactive and sedentary, India, specifically about 70.5% (WHO reports, 2010), suggesting that almost ¾ of the Indian school going population is not moderately physically active for even an average of 60 minute/day (or 150 minutes/week) (guidelines suggested by WHO, 2018) [2].
As per the statistics given by WHO, obesity in children and adolescents is gradually becoming a major public health problem in many developing countries, including India. The prevalence is higher in urban than in rural areas. In 2016, an estimated 41 million children under the age of 5 years were overweight or obese. Nearly half of the children under 5 who were overweight or obese in 2016 lived in Asia. Over 340 million children and adolescents aged 5 -19 were overweight or obese in 2016 (guidelines suggested by WHO, 2018)[1] As we see, physical activity levels in children has declined tremendously due to a variety of factors like change in lifestyle which includes watching television, playing games on computer/ mobile phones for long hours (Xihe Zhu *et al*, 2014)[4], change in eating habits (shift towards frequent snacking, consuming high salt, fat, sugar foods) & various reasons (Michael Sheldrick *et al*,2017) [5] In order to solve this crisis, special attention should be given to physical activity in childhood and

schools have been considered and targeted as one of the most promising settings for reaching and impacting youth (Ridgers N, *et al*, 2007) [6]. Children, however, have been found not to compensate for physical activity after school when physical activity opportunities are restricted during the school day as they have switched to a more sedentary lifestyle (National Academies Press (US); 2013) [7], (Dr. Rashmi Ronghe *et al*, 2016) [8]. Considering this view, an urgent need was felt to carry out assessment of physical activity level in school children of age 10-12 years. These assessment measures can help in implementing new schemes and programs to increase physical activity in children as well as in improving the present programs effectively (Dr. Rashmi Ronghe *et al*, 2016)[8] Physical assessment programs have been extensively carried out overseas as well as in comparatively lesser amounts in terms of Indian context (colossally in southern India) but no major work has been done in western states like Maharashtra as such. And hence, this study was conducted in Mumbai, Maharashtra with a view to assess and understand the physical activity levels in school going children (10-12 years) in order to help in provision of better physical activity plans in the near future.

The study had the following objectives:

General objective:

To assess the physical activity and sleep patterns of school going 10-12 years of age) in Mumbai, India

Specific objectives

- To compare the physical activity levels and sleep patterns of children as per gender and type of schooling.
- To assess the duration, frequency and intensity of physical activity among the school going children.
- To understand the social factors associated with physical activity among school going children.
- To find association between physical activity and anthropometry indices.

Methodology and Materials

The study was a cross-sectional community-based survey, carried out in 5 schools across Mumbai, India, where the observer looked at the physical activity patterns during school hours as well as at home. A random list of 20 schools was prepared and the schools that provided their consent were included in the study. The parents of the children were provided with consent forms which had detailed information of the study and those who signed the consent letters, their children were included in the study. Two rounds were conducted in two schools for the purpose of reliability of the questionnaire. Data collection took place between the months of December 2018, January and February 2019. Ethical approval was sorted by Inter System Biomedica Ethics Committee (ISBEC).

Study participants

The subjects in the proposed study were pre adolescents of 10-12 years of age in the city of Mumbai, Maharashtra, India.

Inclusion Criteria

- Children in the age group of 10-12 years
- Children willing to participate in the study as well as children present on the day of data collection
- Children without mental or physical disability.

Study Tools

2 main tools that were used in the study were the questionnaire and anthropometric measurements.

The self- reported questionnaire that was administered to children who were selected from the schools included various questions related to – demographic details of the parent and the child, questions on role of factors such as participation in sports and games, household chores, physical inactivities such as television viewing and playing computer/video games as well as the duration, intensity and frequency of physical activity as well as their sleep patterns.

Anthropometric data

6 different measures of anthropometry were taken – weight, height, waist circumference, hip circumference, BMI, waist to hip ratio. Each measure was assessed twice and the average of the two readings was used in the analysis.

Statistical analysis

Analyses were performed using SPSS software for Windows (version 25, 2017, IBM Corporation, Armonk, New York, United State). Data are presented as Mean ± SD, median (minimum-maximum) or percentage.

Reliability analysis

Reliability analysis was performed using Cohen's Kappa.

METs (metabolic equivalents)

One MET is defined as the energy cost of sitting quietly, and is equivalent to a caloric consumption of 1 kcal/kg/hour.

Measurement of intensity of physical activity

4 METs are assigned to the time spent in moderate activities and 8 METs for vigorous activities and 1 MET for sedentary activities.

Throughout a week, including activity for work, during transport and leisure time, adults should do at least - 150 minutes of moderate-intensity physical activity OR 75 minutes of vigorous- intensity physical activity OR an equivalent combination of moderate- and vigorous-intensity physical activity achieving at least 600 MET-minutes.

Calculation of MET values from questionnaire: MET (for specific activity) * minutes of activity * days of activity.

Questionnaire VS Pedometer

The observer in a sub sample of 13 students performed a procedure wherein the self-reporting questionnaire was given to the children of the same age group to fill before handing over the pedometers to the children. Pedometers were tucked into the clothes of the children and the steps on the pedometer were noted for 3 days and the steps were converted into MET values using a standard formula. This small sample study was done to find the efficacy and reliability of the questionnaire so as to see if the MET values of Questionnaire coincided or were near equal to that of a pedometer.

Formulas used

1. Speed (m/s) = Distance in meters / Time in minutes
2. Minutes = Seconds obtained / 60
3. 3.5*(MET for walking) * minutes calculated * 7 days of the week

Results

Table 1 gives information about the demographic details of the participants as well as their mean age. There were about 40% children in grade 6th and 60% in grade 7th. A similar

ratio was seen in the gender with 40% females and 60% males. The mean age of the participants was 11.63±0.70 and that of boys was 11.64±0.65 and 11.62±0.78 for the girls.

Table 1: Demographic details of the children

Demographics	Total	N	(%)
Standard	n=301		
6th		122	40.5
7th		179	59.5
Gender	n=301		
Boys		176	58.5
Girls		125	41.5
Religion	n=301		
Hindu		211	77.5
Muslim		35	12.3
Christian		12	4.2
Other		17	6
Demographics	Total (n=301)	Boys (n=176)	Girls (n=125)
Age	11.63±0.70	11.64±0.65	11.62±0.78

*Data represented as frequencies

Anthropometric parameters

The mean height of children in the study was 146.6 ±8.4 cm, weight was 42.4 ±10.2 kg and BMI was 20.1±4.2 kg/m2. *Table 2* gives anthropometric parameters when classified according to gender. There was no significant difference in anthropometric parameters of children when classified according to gender (p>0.05**).**

Table 2: Anthropometric parameters of study population

	Total (301)	Boys (n=176)	Girls (n=125)	P value
Height (cm)	146.6 ±8.4 cm	147.4 ±9.0	145.6 ±7.4	0.060
Weight (kg)	42.4 ±10.2	42.6 ±10.9	42.0 ±9.38	0.632
BMI (kg/m2)	20.1±4.2	20.2 ±4.2	20.0 ±4.2	0.666
Waist circumference	64.3±8.6	65.2 ±8.8	63.4±8.4	0.074
Hip circumference	79.7±9.5	79.2±9.4	80.1±9.5	0.419
Waist to hip ratio	0.81±0.04	0.83±0.08	0.79±0.005	**<0.001**

Data presented as Mean ± SD

Overall 1.7% (N= 5) were children underweight, 52.8% (N=158) had normal BMI, 22.4% (N=67) were overweight and 23.1% (N=69) were obese. There was significant association of BMI cut-off with gender with higher percentage of boys being obese than girls and higher percentage of girls been overweight than boys (p<0.05)

Table 3: Anthropometric parameters when classified according to Gender &Type of school

	Gender (n = 307)			School (n = 20)		
	Boys (n = 177)	Girls (n = 130)	P value	Private (n = 130)	Government (n=143)	P value
Height (cm)	147.6±9.0	145.4±7.4	**0.024***	146.1±7.7	147.3±9.1	0.189
Weight (kg)	42.5±10.8	41.8±9.4	0.562	44.3±10.2	39.9±9.7	**0.001****
BMI (kg/m2)	19.4±4.2	19.8±4.0	0.457	20.7±4.2	18.2±3.5	**0.001****
Waist circumference (cm)	65.1±8.6	63.7±8.5	0.167	66.0±9.2	62.8±7.5	**0.001****
Hip circumference (cm)	79.3±9.1	80.3±9.4	0.351	81.9±9.4	77.2±8.6	**0.001****
Waist to Hip ratio	0.8±0.07	0.8±0.06	**0.001****	0.8±0.1	0.8±0.1	0.334

*Data presented as Mean ± SD *p <0.05 for comparison between gender

Table 4: Comparison of BMI and waist circumference in children from private & government schools

	Private school	Government school	Total	$\chi 2$ value	P value
Total (n)	160	140	300		
High wait circumference	33(20.2%)	11(7.9%)	44(14.5%)	14.306	**0.003***
Overweight	46(28.6%)	24(17.1%)	70(23.3%)	37.977	**0.003***
Obese	51(31.7%)	15(10.7%)	66(21.9%)		

Z scores: High waist circumference= >0.525, above 70th

Overweight= 0.55-1.34 (males), 0.67-1.64 (females)

Percentile Obese= >1.34 (males), >1.64 (females) (as per Revised IAP scores, 2015

Table 5: comparison of gender and sleep patterns

		Boys	Girls	Total	Z score	P value
1.	Sleep more than 8 hours	2.63[3(0-4)]	2.65[3(0-4)]	2.64[3(0-4)]	-0.152	0.879
2.	Sleep less than 5 hours	2.22[2(0-4)]	2.5[3(0-4)]	2.34[2(0-4)]	-1.43	0.153
3.	Feel tired after waking up in the morning	1.75[1(0-4)]	1.84[2(0-4)]	1.79[2(0-4)]	-0.525	0.6
4.	Have trouble falling asleep at night	2.21[2(0-4)]	2.37[2(0-4)]	2.27[2(0-4)]	-0.959	0.337

Data presented as Mean [median (minimum-maximum)]

Note:

For Q 2. Code
1. Almost never
2. < once a week
3. Once a week
4. 2/3 days a week
5. Almost every day

For Q 1,3,4. Code
1. Almost everyday
2. 2/3 days a week
3. Once a week
4. < Once a week
5. Almost never

Fig 1(a): Sleeping for less than 5 hours at night

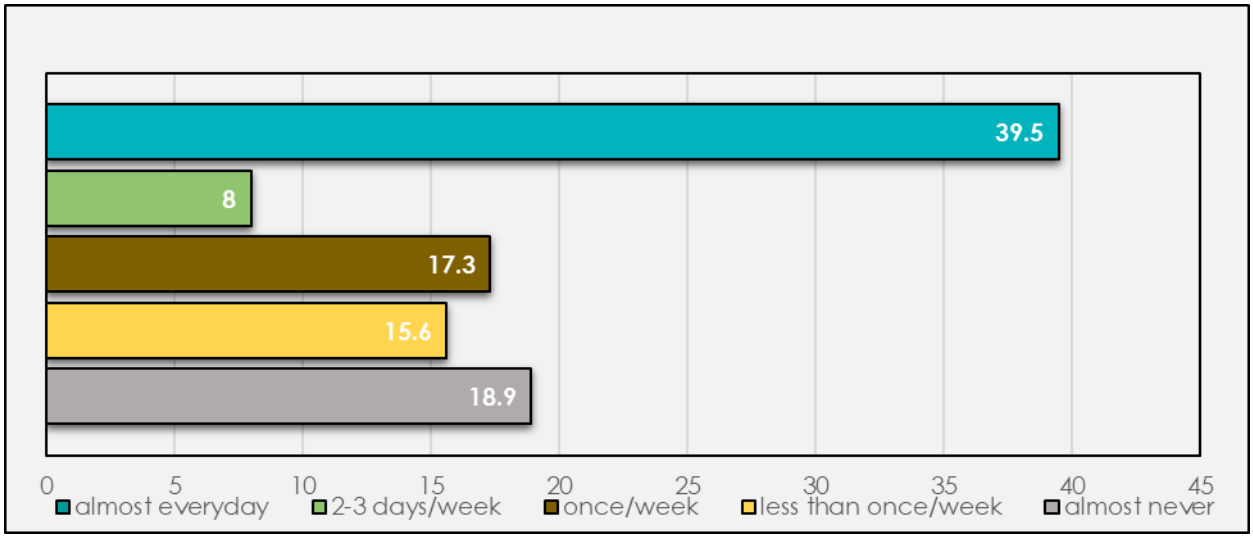

Figure 1(a) gives the percentage of children who slept for less than 5 hours in a day. This figure suggests that about 2/5th (40%) of the children slept for less than 5 hours every day. 20% children reported that they never slept for less than 5 hours a day.

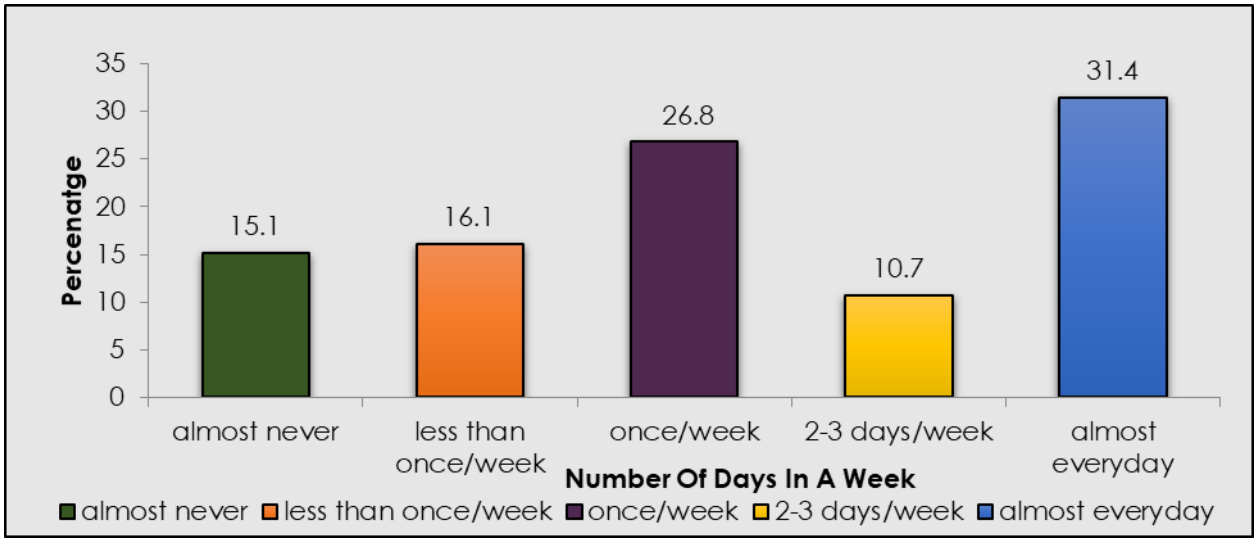

Fig 1(b): Graph showing the frequency of having trouble falling asleep or sleeping too much

Figure 1(b) shows graph which depicts the frequency of having trouble falling asleep or sleeping too much. 31% of children reported that they had trouble falling asleep or were sleeping too much and only 15% reported of never having the issue which shows that more than 1/3rd of children were unable to sleep properly or have a good sleep every night and hence slept for less than 5 hours every day as reported in the Figure 1

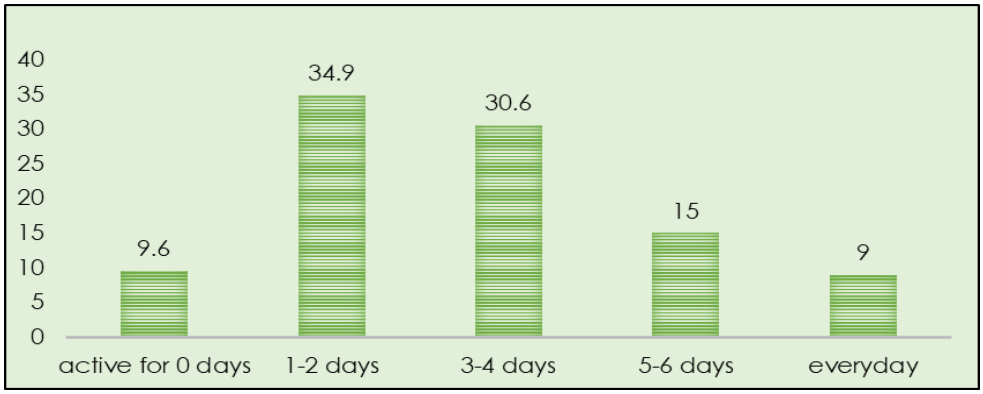

Fig 2: Number of days the child was active during the day

Figure 2 shows a graph of how many days the children were active during the day (doing physical activity such as sports or playing games). Out of the total population only 9% children were active on all 7 days of the week while about 35% children were only active for about 1 or 2 days of the week. Also, almost 10% of the population reported that they were sedentary and did not engage in any form of physical activity throughout the day.

Almost 40% of the children played with their peer almost on a daily basis and about 30% reported that their friends appreciated their sports skills on a daily basis. On an average 2/3rd of the children said that their parents encouraged them to be physically active and play sports or games either once, twice or on a daily basis. And about 40% of the children reported that they played games with their family at least once a week. 34% children were told by their family members that they were doing good in their sports on a daily basis.

Table 6: Comparison and association between parental and peer support with activity level.

	Correlation	**Significance (p value)**
Parents		
Encouraged you to do any physical activity (games/ sports)?	0.102	**0.035***
Have played a game or a sport with you?	0.029	0.554
Have provided transportation to a place where you can do any physical activity or play sports?	0.128	**0.008****
Have watched you participate in physical activities or sports?	0.156	**0.001****
Have told you that you are doing well in sports?	0.112	**0.02***
Peers		
Encourage/ call you to do physical activities or sports with them?	0.211	**<0.001****
Play sports with you?	0.136	**0.005****
Tell you that you are doing well or you are good at playing sports?	0.005	0.916

Data represented as p value (Kendall taub), p value<0.005*, p value<0.001** (These values indicate positive association)

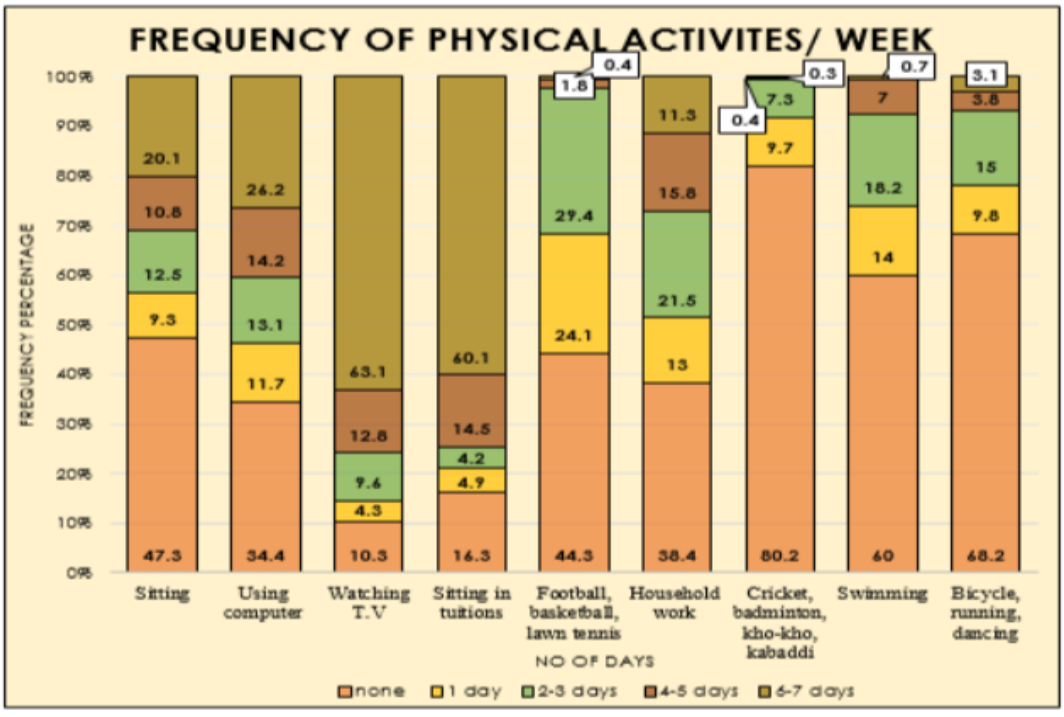

Fig 3: Graph showing physical activity levels of the children for a week

Figure 3 shows information of various physical activities performed by the children during a particular week. The figure includes all forms of physical activity ranging from sedentary to moderate to vigorous exercises. The most common games that the children played were football, cricket, badminton, and bicycling. However, apart from this about 60% engaged in higher sedentary levels in comparison to moderate and vigorous activities on a daily basis

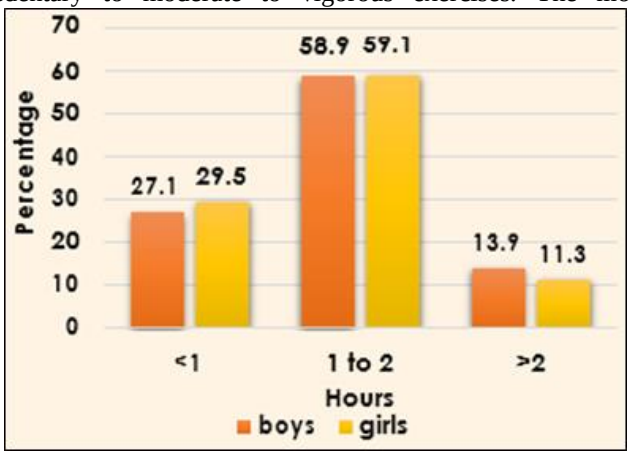

Fig 4(a): Duration of TV watching

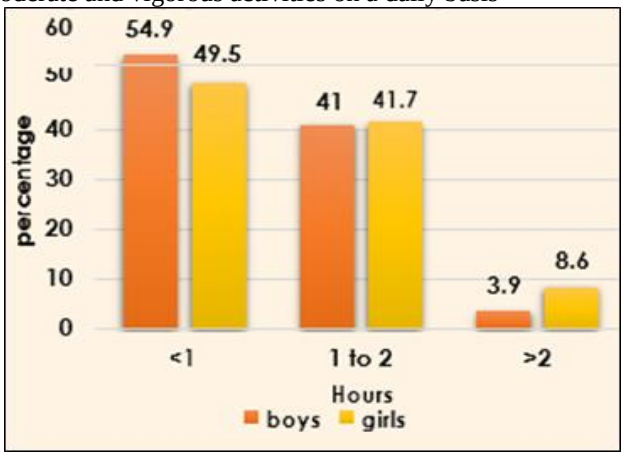

Fig 4 (b): Duration of computer use

Figure 4 (a) and figure 4 (b) show the duration of screen time for more than 3 days a week. This data is compared between the two genders where TV watching was found to be the same in both, boys and girls (for 1-2 hours/day) and screen time was also kind of similar for both them. However, more number of girls used computers for a period of more than two hours than boys.

Table 7: Duration (minutes) of physical activity performed by the students

Minutes	Football, basketball, lawn tennis	Cricket, badminton, kabaddi	Swim	Bicycle, running, dancing	Household work	Using computer	Watching T.V	Sitting in tuitions	Playing board games
0	**115**	**116**	**231**	**157**	**194**	**97**	**20**	**45**	**165**
30-59	49	70	22	42	46	43	39	7	59
60-89	61	75	28	49	19	61	83	16	28
90-119	42	6	1	11	2	9	18	12	6
120	**0**	**0**	**0**	**7**	**4**	**40**	**57**	**92**	**8**
>120	**0**	**0**	**0**	**0**	**0**	**17**	**50**	**95**	**0**

*Data represented as frequencies. Here the *Figure 7* shows that majority of the children did not engage in high intensity or moderate intensity physical activities throughout the week.

Table 8: Comparison of MET values with gender

	N	Mean	SD	P value
Total	269	1631.02	595.10	0.613
Boys	159	1646.34	587.58	
Girls	110	1608.84	607.84	

Data represented as Mean and SD (p value)

Table 9: comparison of MET values with type of schooling

	N=279	Mean±SD	Correlation (p value)
Private	134	1716.23±559.6	0.183 (0.19)
Government	135	1546±618.8	

Data represented as Mean±SD*p value

Table 9 shows the comparison of the mean MET values between the type of schooling. The mean MET of private schools was *1716* while that of government schools was *1546.* There was a significant difference in the mean MET values of both the type of schools where the MET of private schools was higher than that of the government schools.

Table 10: Correlation between MET values by pedometer and questionnaire

	N	Correlation	P value
Pedometer	13	0.901	<0.001
Questionnaire	13		

*Correlation was also assessed using Pearson's Correlation

Table 10 shows a correlation between the pedometer as well as the questionnaire. When the MET values calculated by the questionnaire were checked with the MET values calculated from the pedometer steps, both of them had a strong positive correlation suggesting that the children seemed to give correct answers thus suggesting that the questionnaire was reliable and can be used as a validated questionnaire.

Reliability analysis

Reliability analysis was performed using Cohen's Kappa. There was fair agreement for test- retest analysis for most of the questions. Some questions even had moderate agreement

***Dis*cussion**

The strength of the study was that the MET values for each physical activity was calculated, the questionnaire was validated as well as the parental and peer support was assessed. While assessing the physical activity levels, it was found that majority of the children did not fulfill the WHO recommendations of being physically active on all 7 days of the week for at least 1 hour. This study had similar findings to a study conducted in 2016 by Dr. Rashmi Ronghe *et al*, 2016[8] as well as by Michael P. R. Sheldrick,2018[5]. A systemic review conducted in 2015 by David Jime´ Nez-Pavo´ N *et al*, 2010[9], reported that BMI and adiposity was inversely related to physical activity, however, we found no association between physical activity and BMI or waist circumference in both the genders. Findings similar to our

study were seen in a few studies including a study conducted by Michael P. R. Sheldrick, 2018[5]. We also found that the physical activity levels of children in the private schools was higher as compared to the children from the government schools, despite the fact that the private school children had higher prevalence of overweight and obesity than the children of government schools. The physical activity levels in both the genders was almost the same with no significant difference which was similar to a study conducted by Runar Vilhjalmsson *et al*, 2003[10]. The physical activity levels of children in the private schools was higher as compared to the children from the government schools, despite the fact that the private school children had higher prevalence of overweight and obesity than the children of government schools. This finding coincided with the findings from the study conducted in Surulere by A Akodu *et al*., 2012[11]. Our study illustrated a strong association between parental support in increased physical activity in children similar to studies conducted by Yang Liu *et al* in 2017[12], Natalia Liszewska *et al*, 2018[13], Joanna Kirby, 2011[14]. These studies revealed that higher encouragement, role modelling, financial support as well as engagement had greater influences on the physical activity levels of children. Our findings coincided with Merav W. Efrat *et al*, 2009[15] and Tara Finnerty *et al*, 2010[16] which pointed out that verbal encouragement, praising and participating by the peers had positive influence on the duration or the activity of the children.

Conclusion

Aim of this study was to assess the duration, frequency and intensity of physical activity in 10-12 year-old children across Mumbai suburbs. Contrary to the findings in former literature, few findings that emerged out did not have any correlation. For e.g. no association was found between MET values based on gender. However, there were few findings which were very significant. For e.g. there was a difference in the gender in terms of BMI, where more number of boys were found to be obese and higher prevalence of overweight was seen in girls and parental and peer support was very effective in inducing and increasing the physical activity in children. More such studies can be conducted in a larger setting with more effective and accurate tools and a more accurate result can be obtained and such studies can be used to implement various programs and schemes for the school going children in order to improve their physical activities.

References

1. https://www.who.int/en/news-room/factsheets/detail/obesity-and-overweight
2. https://www.who.int/news-room/factsheets/detail/physical-activity
3. World Health Organization. Global Physical Activity Questionnaire. Available at: http://www.who.int/ncds/surveillance/steps/resources/GPAQAnalysis_Guide.pdf . Accessed, 2017.
4. Xi B, Mi J, Zhao M, Zhang T, Jia C *et al*. Trends in Abdominal Obesity Among US Children and Adolescents. Pediatrics. 2014; 134(2):e334–e339. https://doi.org/10.1542/peds.2014-0970
5. Sheldrick M, Tyler R, Mackintosh K, Stratton G. Relationship between Sedentary Time, Physical Activity and Multiple Lifestyle Factors in Children. Journal of Functional Morphology and Kinesiology. 2018; 3(1):15. https://doi.org/10.3390/jfmk3010015
6. Ridgers ND, Stratton G, Fairclough SJ, Twisk JW. Children's physical activity levels during school recess: a quasi-experimental intervention study. The international journal of behavioral nutrition and physical activity. 2007; 4:19. doi:10.1186/1479-5868-4-19
7. Committee on Physical Activity and Physical Education in the School Environment; Food and Nutrition Board; Institute of Medicine; Kohl HW III, Cook HD, editors. Educating the Student Body: Taking Physical Activity and Physical Education to School. Washington (DC): National Academies Press (US); 2013 Oct 30. 2, Status and Trends of Physical Activity Behaviors and Related School Policies.
8. Ronghe DR, Gotmare DN, Kawishwar DS. Physical activity level of school children of age 10-13 years. International Journal of Biomedical and Advance Research. 2016; 7(6):281. doi:10.7439/ijbar.v7i6.3330
9. Jiménez Paýn D, Kelly J, Reilly JJ. Associations between objectively measured habitual physical activity and adiposity in children and adolescents: Systematic review. International Journal of Pediatric Obesity. 2010; 5(1):3-18. https://doi.org/10.3109 /17477160903067601
10. Vilhjalmsson R, Kristjansdottir G. Gender differences in physical activity in older children and adolescents: The central role of organized sport. Social Science and Medicine. 2003; 56(2):363-374. https://doi.org/10.1016/S0277-9536(02)00042-4
11. Akodu A, M Ibeabuchi N, D Ogunmuyiwa Oluwakemi, Akinbo S. Comparative Study Of The Effect Of Recreational Physical Activities On Body Composition Among Pupils Of Public And Private Primary Schools. The Internet Journal of Public Health, 2012, 2(1).
12. Liu Y, Zhang Y, Chen S, Zhang J, Guo Z, Chen P. Associations between parental support for physical activity and moderate-to-vigorous physical activity among Chinese school children: A cross-sectional study. Journal of Sport and Health Science. 2017; 6(4):410-415. https://doi.org/10.1016/j.jshs.2017.09.008
13. Liszewska N, Scholz U, Radtke T, Horodyska K, Liszewski M, Luszczynska A. Association between Children's Physical Activity and Parental Practices Enhancing Children's Physical Activity: The Moderating Effects of Children's BMI z-Score. Frontiers in psychology. 2018; 8:23-59. doi:10.3389/fpsyg.2017.02359
14. Kirby J, Levin KA, Inchley J. Parental and Peer Influences on Physical Activity among Scottish Adolescents: A Longitudinal Study. Journal of Physical Activity and Health. 2016; 8(6):785-793. https://doi.org/10.1123/jpah.8.6.785
15. Efrat MW. The Relationship between Peer and/or Friends & quot; Influence and Physical Activity among Elementary School Children: A Review. Californian Journal of Health Promotion. 2009; 7:48-61. Retrieved from. https://pdfs.semanticscholar.org/d849/af02409b902f0cb4f2fbdbfb7471ec1a88b9.pdf
16. Finnerty T, Reeves S, Dabinett J, Jeanes YM, Vögele C. Effects of peer influence on dietary intake and physical activity in schoolchildren. Public Health Nutrition. 2010; 13(3):376-383. https://doi.org/10.1017/S1368980009991315
17. Khadilkar V, Khadilkar A. Revised Indian Academy of Pediatrics 2015 growth charts for height, weight and body mass index for 5-18-year-old Indian children. Indian Journal of Endocrinology and Metabolism. 2015; 19(4):470. https://doi.org/10.4103/2230-8210.159028