Research Report

Physical activity level using pedometry of Filipino pre-adolescents

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ABSTRACT

Background and Objectives: An active lifestyle among children and adolescents plays an important role in the normal growth and development. However, studies from different countries have shown a decreasing participation of children in physical activity. In the Philippines, very little is known of pre-adolescents involvement in physical activity. This study aims to 1) determine the physical activity level of pre-adolescents using pedometers, and 2) examine the factors that could affect the physical activity level of children, i.e., sex, age, body mass index, number of hours watching television/using computers and kinds of transportation used in going to school. ***Methodology:*** Descriptive cross sectional study. 90 students (41 boys with mean age of 11.4 ± 0.8 with mean BMI of 20.8 ± 5.0 kg/m^2 and 49 girls with a mean age of 11.5 ± 0.7 with a mean BMI of 20.1 ± 4.1 kg/m^2)from a private school in Manila, Philippines participated in the study from July to August 2006. Physical activity was measured using pedometers which counted the steps taken per day ***Results:*** The overall pedometer reading was 8085.5 ± 2839.3 steps per day for the total population with a statistically higher mean steps/day of 8785.0 ± 3000.5 for boys and 7499.7 ± 2535.2 for girls (p value = 0.03). Only 5 of 41 boys and 5 of 49 girls were able to meet the recommended pedometers steps of 13,000 steps/day and 11,000 steps per day respectively. Sex, body mass index and mode of transportation were factors that affected the mean pedometer steps. ***Conclusion:*** A large majority of the study population was not able to meet the recommended steps per day to maintain a healthy lifestyle. Males, lower body mass index and walking to school had a positive association with higher mean pedometer count. A decreasing physical activity pattern could increase the likelihood of having lifestyle diseases in these children in the coming years. ***Recommendations:*** Children should be encouraged to have a more active lifestyle, not only in school, but also with the family.

Key words: *pre-adolescent, pedometer, physical activity*

INTRODUCTION

Physical activity is defined as "any bodily movement produced by contraction of the skeletal muscle that increases energy expenditure above the basal level which includes activities such as play, household chores, organized sports and exercise." The relationship between regular physical activity and good physical and mental health is well established.[1,2,3,4,5] Regular physical activity are non-pharmacological agents which could prevent and treat hypertension, hyperlipidemia, diabetes mellitus [6] and obesity [7].

However, even with the known beneficial effects of the physical activity in disease prevention, involvement in physical activity of children has been declining steadily in the recent decade. Approximately 20% of U.S. children do not exercise vigorously more than twice per week, with the percentages higher in girls than in boys.[8] Moreover, the age range of greatest decline were from 13-16 years of age in Dutch study [9] , 12-15 years old or 15-18 years old in Finnish study, [10] and 15-18 in U.S. study. [11] A study in the

Philippines assessed the physical activity of Filipino schoolchildren aged 9-16-years old, in selected public and private schools in Metro Manila. It showed that 20.9% and 27.9% of children aged 9 -10 and 11-16 year old were less active.[12]

To promote physical activity in children, the Council on Physical Education for Children in America[13] has issued guidelines for children aged 5-12 recommending that the focus of physical activity is on the daily accumulation of age appropriate physical activity for a minimum of 60 minutes on most, if not all, days of the week with involvement in moderate to vigorous physical activity for 15 minutes per session. On the other hand, the President's Council on Physical Fitness and Sports recommends that children should acquire 11,000 steps per day for girls and 13, 000 steps per day for boys to improve physical activity.[14] There was also emphasis on the need to have moderate to vigorous physical activity. Although no absolute number of minutes was stated, percent of the class time or steps per minute criteria have been recommended for moderate to vigorous physical activity (MVPA) in elementary physical education of 10-15 minutes of MVPA (i.e. 33.33-50% of the class time) within typical 30 min physical education class would significantly contribute to a child's daily activity.

There are a variety of measures of physical activity, namely by self report, [15,16,17] pedometers,[15, 18,19] and the use of double-labeled water [20, 21]. Double-labeled water, calorimetry and accelerometers are considered to be the most accurate methods of measuring physical activity.[22] However, they are expensive and impractical when used in large-scale epidemiological studies.[23] Pedometer measures the number of steps taken by an individual. It contains a horizontal, spring suspended lever arm that deflects with the up and down motion of the hips during ambulation. An electrical circuit opens and closes with each deflection detected and accumulated step count is displayed digitally on a feedback screen.[15] Its validity has been compared with an accelerometer and showed that adjusted for age, pedometer steps per day were correlated with accelerometer steps per day (r=0.74, p<.0001) and with total counts per day with r= 0.86 (p<0.0001). Reliability of the pedometer has been studied and showed the paired t-tests between the numbers of pedometer counts recorded during the two occasions revealed no differences, thereby indicating an absence of a large systematic bias. The intra-class correlations ranged from 0.51 to 0.92 (p value <0.001) across all activities; however, the correlations were weaker for running (0.51-0.77) than those obtained during walking (0.75-0.89) and fast walking (0.61-0.92).[24]

The objective of this study is to determine the physical activity level of pre-adolescents using pedometers. Likewise, it seeks to examine the factors that are associated with the physical activity of children such as such as sex, body mass index and age, mode of going to school and the number of hours watching television or using the computer.

METHODOLOGY

This Ethics permission for this study was provided by the Human Research Ethics Committees of the University of South Australia, University of Santo Tomas and University of the Philippines.

Class lists of grade 5 and grade 6 students of the grade school of a private school in Manila were obtained. The sample size was calculated using Epiinfo Version 6.2 sample size calculator for population (prevalence) studies (Statcalc), with an estimated population of 300 of Grade 5 and 6 boys and girls available for selection. Taking account of gender in the sample, approximately 40 boys and 40 girls were considered necessary to provide a sample with 80% power to detect differences in responses with minimum error (alpha at 0.05). To take account of potential refusals, 300 students were asked to participate in the study. Letters of invitations to join the study were sent home with the children, and informed written consent was obtained from the child and parents, for the child to participate.

Pre-testing of the pedometer's reliability was done by comparing the LCD display of the steps taken in 10 meters with manual counting of the number of steps. No difference was seen in these two methods.

On the first testing day, the children who consented to participate in the study were asked to use light clothing. They were asked to fill out the demographic data. Likewise, height and weight were measured using Detecto scale and stadiometer (Cardinal Detecto, U.S.A.), respectively. During weight and height measurements, the children removed their shoes. The weight was recorded to the nearest ± 0.05 kg. The height was measured to the nearest ±

0.01 centimeter. Both height and weight were measured three times. The mean of the three measurements was used as the mean weight and height since there was no statistical difference among the three measurements using ANOVA. The body mass index (BMI) of the subjects was computed using the formula: weight (in kg) divided by height (in m^2).

An orientation on the proper use of the pedometer (i.e. it should be worn all day except during sleeping time; how to read the pedometer steps; how to reset it; and that it should not be used while taking a bath or in water activities) was given to the students on the same day.

All students who consented were requested to wear a pedometer (Digi-walker SW 200 Yamax, Japan) for a period of 10 consecutive days. Digi-walker SW 200 was the pedometer used because of its high validity among 10 pedometers when compared to the treadmill and the metabolic cart. It did not significantly differ from the counts of the actual steps at any speed and was within ± 1% of actual steps (p value < 0.05).[25] It was placed on the right hip of the subjects and remained in place everyday for the entire study period. The readings for the first three days were not employed in analysis because of the probability that the children could tamper the novel instrument.[26] After the third day, the pedometer was reset to zero by researchers and covered the display with white tape.

The participants continued with their usual activities wearing their pedometer during every waking hour of the next seven days. The researchers went to the students daily to ensure that the subjects were using the pedometer properly. If the student was absent, the researcher called the house to ask if he/she was using the pedometer. The sampling period included a weekend, thus allowing capture a full range of physical activities.

At the end of the seven day period, the total number of steps taken by each participant was recorded, and these steps were divided by seven days to calculate the average number of steps per day for the active study period (Fig 1). Students who were sick during the testing period and those who forgot to use the pedometer for one day or more were excluded in the study.

Data Analysis

Data were entered into a purpose-built workbook and STATA computer software was used for analysis. Descriptive statistics [means and standard deviation (SD)] were used. Data analysis using t-Test and ANOVA was used to analyze the differences between boys and girls, as to age, weight, height, BMI while Chi-square test was used to detect a difference between boys and girls who did or did not attain the recommended number of steps per day, hours spent watching TV/computer and mode of transportation to school.

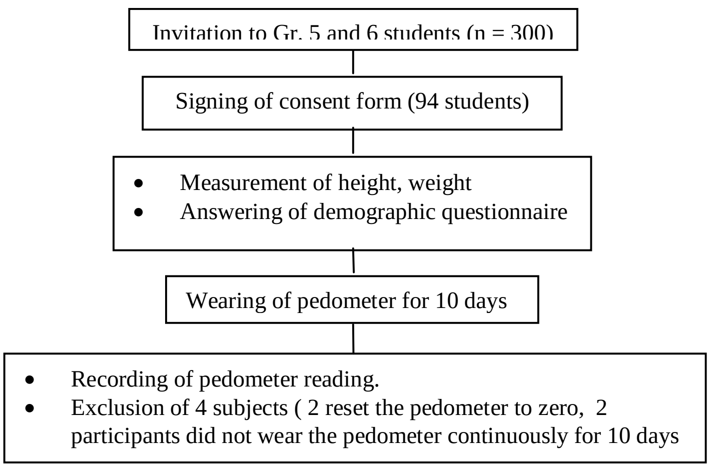

Figure 1. Flow chart of methodology

To classify overweight and obesity, cut offs were based on the International Obesity Task Force standard for overweight and obesity which was age and sex specific (Table 1). [27]

Table 1. **Cut-offs for Overweight and Obese per sex-age**

Age	OVERWEIGHT		OBESE	
	Male	Female	Male	Female
	BMI kg/m^2	BMI kg/m^2	BMI kg/m^2	BMI kg/m^2
10	20	20	24	24
11	21	21	25	25
12	21	22	26	27
13	22	23	27	28

Regression analysis was used to determine if there was any association between the mean pedometer count/day with factors such as gender, age groups, BMI, mode of transportation and time spent in watching television or using the computer. A p value of less than 0.05 was considered significant.

RESULTS

A total of 94 students agreed to be part of the study. However, four subjects were excluded composing of two subjects who reset their pedometers to zero during the study duration and two subjects who did not use the pedometer continuously for 10 days.

Subject Characteristics

Table 2 shows the characteristics of the subjects. Of the total 90 subjects, 45.6% (n=41) were boys and 54.6% (n=49) were girls. The mean age was 11.4 ± 0.8 and 11.4 ± 0.7 for boys and girls, respectively. There was no statistical difference between mean height, weight and body mass index of both genders. 24% and 23% of males and females were overweight while 20% and 10% of the males and females were classified as obese.

Only 7.3 % and 10.2 % of boys and girls respectively were able to follow the recommendation of American Academy of Pediatrics to limit watching television and using computer to less than 2 hours.[35] This was a significantly lower percentage as compared to those who watched television/used computer for more than 2 hours.

Majority of the boys go to school using private cars and/or school service. 17.1 % used the public transportation while 24.4% walked to school. 53.1% of the girls rode private cars or utilized school service going to school. While 24.5% walked to school and 22.4% used the public transportation. Using chi-square, there was a significantly higher proportion of subjects using private cars or school service for both genders.

Table 2. **Subject Characteristics**

	Male (n=41) 45.6%	Female (n=49) 54. 4%	
	Mean ± SD	Mean SD	P value
Age	11. 4 ± 0.8	11.5 ± 0.7	0.82(NS)
Weight (kg)	46.1 ± 14.1	45.3 ± 10.7	0.77 (NS)
Height (m)	148.0 ± 9.0	149.0 ± 6.5	0.26(NS)
BMI (kg/m^2)	20.8 ± 5.0	20.1 ± 4.1	0.48(NS)
No. of hours watching television/ using computer			
• Less than 2 hours	3 (7.3%)	5 (10.2%)	0.47 (NS)
• More than 2 hours	38 (92.7%)	44 (89.8%)	0.00**
Mode of transportation to School			
• private car/school bus	24 (58.5%)	26 (53.1%)	0.77 (NS)
• public transportation	7 (17.1%)	11 (22.4%)	0.34 (NS)
• walking	10 (24.4%)	12 (24.5%)	0.00**

(NS) Not significant * Significant (p-value < 0 05, 2-tailed) ** Significant (p-value < 0 01, 2-tailed)

Mean step count/day

The mean number of steps taken per day by the total population was 8085.5 ± 2839.3. When disaggregated by gender, the boys had a significantly higher mean steps/day of 8785 ± 3000.5 as compared to the girls who had a mean step of 7499.7 ± 2535.2 per day with a p value of 0.03. However, only 5 (12%) of boys and 5 (10%) of girls were able to meet the recommended pedometers steps of 13,000 steps/day and 11,000 steps per day, respectively. A large percentage of the population was not able to achieve the recommended steps with 88% for males and 90% for females with a p value of 0.00.

Association between different factors and pedometer reading

Table 4 shows the mean steps count/ day of the associated factors that may affect the outcome. Of the factors, only age did not affect mean step count for both genders. Overweight and obese girls had a significantly lower pedometer steps compared to their girls with normal BMI with an average steps of 6343.9 ± 1580.8 and 7877.0 ± 2704.1 respectively. However, there was no statistical difference in average step counts for boys with different BMI categories. Boys and girls of normal BMI category had no statistical difference in mean steps/day. While boys who are overweight and obese had a higher average step count compared to the female counterpart (8051.4 ± 2830.9 vs 6343.9 ± 1580.8) with a p value of 0.05.

Boys who walked to school had a higher mean step count as compared to boys who took private car or public transportation to school (8212.5 ± 2973.4 vs 10563.1 ± 2688.2 ; p value = 0.03) . However this trend was not seen in the female population. Boys and girls who took the private car or public transportation had no statistical difference in the mean pedometer count. However, boys who walked to school had a significantly higher count as compared with the girls (10563.1 ± 2688.2 vs 7800.3 ± 2840.6) with a p value of 0.03.

Girls who spend less than 2 hours in television and computer use had a significantly higher mean step count as compared to those who spend more than 2 hours in television and computer use (10488.1 ± 2147.5 vs 7159.9 ± 2364.1) with a p value of 0.00. There was no statistical difference in the mean count for boys spending less than 2 hours and more than 2 hours in front of the television and computer. Boys and girls spending less than 2 hours in front of television and computers had no statistical difference in their mean count. However, males who used the television and computer more than 2 hours had a statistically higher mean steps compared with the females (8797.9 ± 3022.2 vs. 7159.9 ± 2364.1; p value =0.01).

Body mass index had a negative correlation with mean step count per day with a coefficient of -156.3 (95% CI:-285.4, -27.3) while males had significantly higher mean count as compared to

Table 4. **Mean steps per day of different factors affecting the count.**

Factors		Boys	Girls	p value
Age	< 11	8643.9 ± 2346.4	6806.3 ± 2496.6	0.16 (NS)
	11 - < 12	8525.1 ± 2990.4	7873.3 ± 2656.4	0.45 (NS)
	≥ 12	9388.5 ± 2679.9	7566.2 ± 2346.4	0.11(NS)
	p value	0.75 (NS)	0.46 (NS)	
BMI Status	Normal	9420.1 ± 3152.4	7877.0 ±2704.1	0.06 ns
	overweight and obese	8051.4 ± 2830.9	6343.9 ± 1580.8	0.05 *
	p value	0.15 ns	0.05 *	
Mode of transportation to school	Car/public transport	8212.5 ± 2973.4	7401.9 ± 2462.5	0.22 ns
	Walking	10563.1 ± 2688.2	7800.3 ± 2840.6	0.03 *
	p value	0.03 *	0.64 ns	
Hours Spent on TV/Computer Use	< 2 hours	8632.4 ± 4124.2	10488.1 ± 2147.5	0.42 ns
	> 2 hours	8797.9 ± 3022.2	7159.9 ± 2364.1	0.01 *
	p value	0.93 ns	0.00 **	

Legend: (NS) Not significant * Significant (p-value < 0 05, 2-tailed) ** Significant (p-value < 0 01, 2-tailed)

Table 5. **Correlation Coefficient of the different associations affecting physical activity**

FACTORS		COEFFICIENTS	95% CONFIDENCE INTERVAL	p-value
Age	9-10y/o vs. 11y/o	739.5	(-682.8) – 2161.9	0.30 (NS)
	9-10y/o vs. 12-13y/o	986.3	-667.0 – 2639.5	0.24 (NS)
BMI		-156.3	(-285.4) – (-27.3)	* 0.02
Sex		1286.3	116.6– 2546.0	* 0.03
Hours on TV/Computer		-1867.3	(-3931.6) – 196.9	0.08 (NS)
Mode of Transportation	cars vs. public transportation	847.0	(-681.1) – 2375.0	0.27 (NS)
	Cars vs. walking	1508.9	86.7– 2931.2	* 0.04

Legend: (NS) Not significant * Significant (p-value < 0 05, 2-tailed) ** Significant (p-value < 0 01, 2-tailed)

females with a coefficient of 1286.3 (95% CI: 116.6, 2546.0). Walking to school had a positive correlation with the level of physical activity with a coefficient of 1508.9 (95% CI:86.7– 2931.2) Age and hours spend using television or computer did not have significant correlation with the mean steps per day (Table 5).

DISCUSSION

Our study showed that most the subjects were not able to perform the recommended steps per day as suggested by the President's Council for Physical Fitness and Sports. [14] In comparing the results from other countries, the subject population walked less steps as compared to American, Swedish and Australian children aged 6 to 12 [28] and with children from New Zealand with an average of 16,133 ± 3,864 and 14,124 ± 3,286 steps per day on weekdays for males and females respectively. [29]

Sex, body mass index and mode of transportation are the factors that had significant correlation with the level of physical activity in children. Similar results have been seen in different researches. Studies by Duncan et al (2006)[29], Raustorp et al (2004)[30] and Tudor Locke (2003)[31] consistently showed that there were gender differences in the physical activity level with males being more physical activity as compared to females.

Two recent studies by Sulemana (2006)[32] and Butte (2007)[33] which utilized accelerometers as measures of physical activities showed the influence of body mass index with physical activity level. Sulemana (2006) studied girls of different ethnicity in the United States and showed that there was a negative correlation between BMI and after-school activity ($r = -0.28$; $p < 0.05$) and between BMI and 24-h mean activity ($r = -0.37$; $p < 0.05$). Further grouping the children in normal BMI, at risk for overweight and overweight, there was a significant difference in the mean accelerometer counts among the three BMI categories in the after school and total daytime activity with a p value of 0.038 and 0.029 respectively, with those who are overweight obtaining the lowest mean accelerometer count. Butte (2007) compared physical activity of overweight and non-overweight Hispanic children in America and showed that the total activity counts were significantly higher in boys ($p = 0.001$) and in non overweight children ($p = 0.002$). The findings in our study showed similar results with these two studies.

Walking to school correlated with the physical activity levels of pre-adolescent school children. A study involving Danish children showed that participants who walked to school consistently recorded a significantly higher accelerometer counts with a mean of 737.4 ± 234.8 as compared to those who used passive transport with a mean of 624.4 ± 218.0 counts per minute (p value = 0.002). [34] A study by Cooper (2003)[35] of primary school children showed that those who walked to school were more active than those who traveled by car using an accelerometer with a count/ minute of 712 ± 206.7 vs 629.9 ± 207. 2. Analysis by gender also showed that the difference was seen only in boys.

Our study was able to recognize some barriers in the increasing physical activity level in children. However, there are environmental and educational factors that could influence the physical activity levels of children. Environmental barriers include the access to public facilities and neighborhood safety.[36] In the school where the research was undertaken, there was no available open or covered court where the children can play and engage in a variety of sports. Although there is a playground found across the school, the children were only allowed to play there during physical education classes when a teacher is present to supervise them.

In the Metro Manila area, there are very few sports facilities and playground that are available for use of the general public. The most widely available sports facility found in town centers is the basketball court since basketball is the most popular sports in the Philippines.[31] This again will promote gender differences in the physical activity pattern because this sport is popular only with males and not with females.[31,33]

In the school level, there has been a de-emphasis on the school curriculum in physical education class. Physical education classes are only held one to two times a week with duration of 45 to 60 minutes which would promote physical inactivity in children. A study by Li (2006) showed that a lack of extracurricular activities and sports meeting were significantly associated in inactivity while physical education classes were inversely associated with inactivity.[36]

CONCLUSION

The study showed that pre-adolescent children are generally physical inactive. This could result to a strong negative impact in the health situation in the Philippines in the next decade. Remediation should be started in children in the primary schools so as to promote improvement and involvement in physical activity and prevent possible cardiovascular morbidities associated with inactivity. This would include increasing the number of school periods for physical education, inclusion of physical activity games in academic subjects and encouraging of students to play during recess and lunch time.

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