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Pedometer Assessed Physical Activity Levels of Adolescents in a Selected School in Manila

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ABSTRACT
An active lifestyle among children and adolescents plays an important role in their 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 adolescent's involvement in physical activity. **Objective:** To determine the physical activity (PA) levels using pedometers of the adolescents in Metromanila and factors associated with the level of physical activity. **Method:** This study is a cross sectional study assessing physical activity patterns using the Yamax Pedometer (SW-200) of adolescents in a selected school in Metromanila. **Results:** A total of 90 males (15.17 ±1.38; BMI =21.69 ± 4.6 kg/m2) and 78 females (14.85 ± 1.19; BMI = 21.89 ± 4.9 kg/m2) participated in the study. Males had a mean number of steps 10,933.18 ± 4189.5/day while females had a mean of 8307.47 ± 4767.45 steps/day, with males having a significantly higher mean count (p value =0.002). Being male and regular physical exercise were factors associated with a higher pedometer count with a ß (SE) of -171.8 ± 744.1 (95% CI: -2941.3, - 2.5) and ß (SE) 775.6 ± 289.8 (95% CI: 203.4, 1347.8), respectively. Conclusion: Males were generally more active than female adolescents with females having a lower step count compared to studies from other countries. Participation in regular physical activity should be encouraged to prevent the increasing prevalence of lifestyle related diseases.

INTRODUCTION
A decrease in physical activity is one of the major contributory factors that has increased the prevalence of obesity, hypertension, and diabetes mellitus in children in recent years.[1] Children who are physically inactive have a higher likelihood of being inactive as adults. This increases their predisposition in developing lifestyle diseases when they become adults.[2] Despite the importance of having an active lifestyle in disease prevention, there is a general trend of a steady decline in involvement in physical activity during adolescence.[3,4]

Physical activity is usually assessed by physical activity recall questionnaires that have limitations such as the inability of the children to accurately recall activity levels and their overestimation or underestimation in participation in different physical activities.[5] Recently, there has been an increasing number of research studies that utilized pedometers as measures of physical activity.[6,7] Pedometers are relatively simple motion sensors that record the acceleration and deceleration of movement in one direction and are normally used to estimate the number of steps taken over a period of time.[8] Accumulated evidence indicates that pedometers are agreeable compared to accelerometers, VO_2 max, direct observation, and self-reports of physical activity.[9]

In 2002, it was advised by the President's Council on Physical Fitness that children should acquire 11,000 steps/day in order to promote physical fitness.[10] A more recent proposal of Tudor Locke that was based on data from Australia, United States, and Sweden has increased the recommended steps to 12,000 steps per day for girls and 15, 000 steps for boys in order to maintain a healthy body composition.[8] But this may not be an appropriate guideline for adolescents. Studies have shown that girls aged 5 to 16 from Auckland, New Zealand had a mean weekday step counts of 12,597 ± 3,630, while a study in the United States showed that high school students had a mean step/day that ranged from 10,329 to 11,564 steps/day.[11,12] Further studies are still needed to determine the recommended mean steps/day needed by adolescents to promote healthy outcomes. It is therefore the objectives of this study to determine the physical activity level of adolescents in a selected school in Manila using pedometers and to correlate the factors that are associated with the physical activity of children such as such as gender, body mass index, age, being a varsity athlete, mode of transportation to school, and the frequency of exercise in a week.

METHODOLOGY

Ethics permission for this study was provided by the College of Rehabilitation Sciences Research Ethics Committee of the University of Santo Tomas.The sample size was calculated using Epinfo Version 6.2 sample size calculator for population (prevalence) studies (Statcalc). With a total population of 1816 students and an estimated prevalence of 20.9% of the population as physically inactive and a worst acceptable prevalence of 27.9%, for an alpha of 5% and a power of 95%, the sample size calculated was 121 students. [13] The participants were randomly chosen using the Excel generation of randomized numbers. Consent forms were signed by both parents and students.

Pre-testing of the reliability of each pedometer (Yamax Digi-walker SW 200) was performed by comparing the LCD display with manual counting of the number of steps. The researchers conducted a 20-step walk test. This was done by walking 20 steps at a normal walking pace wearing the pedometer and simultaneously counting the actual steps taken. There was no difference between the pedometer count and the manual counting of the number of steps. The reliability of the assessors in measuring height and weight was also performed. Using an ANOVA, the p value of 0.99 was obtained.

On the first testing day, the participants who consented to take part in the study were asked to wear light clothing. They filled out the demographic data sheet which included birth date, high school year level, address, mode of transportation to school, being a varsity athlete, and regular participation in sports or exercise. Likewise, height and weight were measured using a Detecto scale and stadiometer (Cardinal Detecto, U.S.A.), respectively. The weight was recorded to the nearest $\pm$ 0.05 kg and height was measured to the nearest $\pm$ 0.01 centimeter. The body mass index (BMI) was computed using the following formula: weight (kg) divided by height^2 (m).

After this, a brief orientation on the proper use of the pedometer was conducted. The pedometer (Yamax Digi-walker SW 200, Japan) was then attached to the right hip and they were requested to wear it for a period of 5 consecutive days, which consisted of 3 week days and 2 weekend days. Digi-walker SW 200 was used because of its high validity among 10 pedometers when compared to the treadmill and the metabolic cart.[14] According to Gretebeck and Montoye, a monitoring frame of five to six days (including weekend days) of pedometer data collection produced less than 5% error.[15] Each night, the participants were asked to record the number of steps taken during the day in a record sheet. Students that were sick during the testing period and those who forgot to use the pedometer for one day or more were excluded in the study.

TREATMENT OF DATA

The mean pedometer count during weekdays was computed by taking the average of the pedometers steps for three consecutive weekdays while the mean pedometer counter during weekends was computed by taking the mean of the pedometer steps for the weekend. Total pedometer count was the average of the mean pedometer count during weekdays and weekends.

The participants were classified as having normal BMI, overweight,and obese using the sex and gender specific cut-off points set by the in the International Obesity Task Force.[16]

The factors affecting the pedometers were treated dichotomously. For frequency of exercise, those who did not exercise and those who exercised only with a maximum of three times a week were considered as a group who exercised inconsistently, while those who exercised 4-days or more per week were considered as the group who regularly exercised. For the mode of transportation, those who used cars, public transportation, and school bus service were classified as the group who did not walk to school while those who walked were the other group.

STATISTICAL ANALYSIS

Data were entered into a purpose-built MS Excel workbook and the SAS 8.2 was used as the statistical software. Descriptive statistics [means and standard deviation (SD), percentages] were used for anthropometric measures, demographic details, pedometers counts, and descriptors of physical activity. The student t-test was utilized to analyze the differences between genders on the anthropometric measurements and pedometer counts. An ANOVA was used to analyze the difference in pedometer steps of the age groups and BMI categories.

Multivariate regression analysis was utilized to analyze if there was any association between the mean pedometer count per day with variables such as gender, age groups, BMI, walking to school, being an athlete, and those engaging in regular physical exercise. The ß ± standard error and 95% confidence interval was reported for each of the variable. A p-value of less than 0.05 was considered significant.

RESULTS

Subject Profile

One hundred seventy-six of the 185 students invited to participate in the study agreed to be part of the study. There were eight drop outs because of the following reasons: one got sick, four failed to wear the pedometers for two days and three lost the pedometers, bringing the total number to 168 (95.4%) students who were able to complete the study.

Table 1 presents the profile of the subjects. Out of the total number of subjects (n=168), 53.6% were males and 46.4% were females. The males were significantly taller and heavier than females. There were more male athletes and males were more involved in regular exercise as compared to the females.

Table1: Subject Profile

	Males n=90 (53.6%)	Females n=78 (46.4%)	p value
Age	15.2 ±1.4	14.9 ± 1.2	ns
<14 y/o	24 (26.7%)	20 (25.6%)	ns
14-15 y/o	16 (17.8%)	20 (25.6%)	ns
15-16 y/o	25 (27.8%)	22 (28.2%)	ns
<16 y/o	25 (27.8%)	16 (20.5%)	ns
Height (m)	1.6 ± 0.8	1.6 ± 0.1	**<0.001**
Weight (kg)	58.6 ± 14.5	53.0 ± 12.3	**0.0074**
BMI	21.7 ± 4.6	21.9 ± 4.9	ns
Normal BMI (n=118)	60 (66.7%)	58 (74.4%)	ns
Overweight (n=39)	25 (27.8%)	14 (17.9%)	ns
Obese (n=11)	5 (5.5%)	6 (7.7%)	ns
Varsity Athletes			
Athlete (n=18)	15 (16.7%)	3 (3.8%)	**0.004**
Non-Athlete (n=150)	75 (83.3%)	75 (96.2%)	ns
Mode of Transportation to school			
Walking to school (n=18)	8 (8.9%)	10 (12.8%)	ns
Not walking to school (n=150)	82 (91.1%)	68 (87.2)	ns
Physical exercise per week			
Regular physical exercise	22 (24.4%)	4 (5.1%)	**0.0004**
no/infrequent physical exercise	68 (75.6%)	74 (94.9%)	ns

ns: not significant

Pedometer Count During Weekdays, Weekends, and Total Count
Table 2 shows the total mean pedometer count and the pedometer count during weekdays and weekends. The males have a significantly higher mean counts compared to the females for the total step count during both weekdays and weekends. There was a significantly higher mean pedometer count during weekdays than in weekends for both genders.

Table 2. Weekday, Weekend and Total mean steps/day of different age groups of males and females

	Weekday count Mean ±SD			Weekend Count Mean ±SD			Total count Mean ±SD		
Age group	Males	Females	p value	Males	Females	P value	Males	Females	P value
Total	11,458.7* ±4,301.8	9497.6** ±5911.5	0.01	10,407.7* ±5366.4	7117.3** ±4541.7	<0.001	10,933.2 ±4189.5	8307.5 ±4767.5	0.002
<14 y/o	11491.7 ±5379	10490.5 ±8638.3	ns	10078 ±4970.5	6888.8 ±4953.2	0.03	10784.9 ±4720.4	8689.6 ±6550.6	ns
14-15 y/o	12007.4 ±4096.2	8252.3 ±3978	0.009	10534.9 ±8031	5996.6 ±3184.1	0.04	11271.0 ±5138.9	7124.5 ± 3144.4	0.005
15-16 y/o	10735.4 ±4257.2	9494.8 ±4807.2	ns	9044.6 ±4295.1	6682.2 ±5427.1	ns	9890.0 ± 3755.9	6052.2 ± 4592.6	ns
> 16 y/o	11799.1 ±3379.1	9817.2 ±5383.1	ns	12005.7 ±4432.1	9402.1 ±3624.9	0.04	11902 ± 3303.3	9609.6 ±4040.7	0.05
p value	ns	ns		ns	ns		ns	ns	

ns: not significant
** difference between mean pedometer count of males during weekday and weekend was significant, p value =**0.05***
*** difference between mean pedometer count of males during weekday and weekend was significant, p value =**0.000001***

The results of the total mean pedometer count, mean pedometer count for weekdays, and mean pedometer count for weekends for the age groups of both genders are seen in Table 2. The mean pedometer count during weekdays was significantly different between both genders only for the 14 -15 age group while the pedometer count during weekends was significantly different between both genders in all age groups except for the 15 -16 age group. The total mean count was significantly higher in males as compared to females in age group 14 -15 and > 16 years of age with p-value of 0.005 and 0.05 respectively.

Using multivariate regression analysis, the factors that significantly affected the mean pedometer count were being male with ß = -1471.8 ± 744.1(95% CI: -2941.3, - 2.5) and exercising regularly with a ß= 775.6 ± 289.8 (95% CI: 203.4, 1347.8) (Table 3).

Table 3. Beta coefficient of the different variables affecting mean pedometer counts

Predictor Variables	Beta (SE)	95% Confidence interval	p-value
Male gender	-1471.8 ± 744.1	-2941.3, - 2.5	**0.05**
Age	235.6. ± 308.5	-373.6 ,844.8	**ns**
Body mass index	4.4 ± 72.4	-138.6 ,147.4	**ns**
Being an athlete	-1122.3 ± 1267.1	-3624.6 ,1379.9	**ns**
Regular physical exercise	775.6 ± 289.8	203.4 ,1347.8	**0.008**
Walking to school	**468.8 ± 306.7**	**-136.8- 1074.4**	**ns**

DISCUSSION
The study provides information on the physical activity level using pedometer step counts of Filipino adolescents and assessed different factors that influenced their level of physical activity. Comparing the results to studies using pedometers, it showed that the Filipino adolescent males' physical activity level were similar to other adolescents, but females had a lower physical activity level compared to females of other countries.[11,12,17,18] A study by Tudor-Locke that investigated the physical activity pattern of Filipino adolescents in Cebu City showed that the common physical activities females engaged in were household chores. There was no sport that was commonly participated in by females. This could explain the lower mean step count of Filipino females as compared to females from different countries.[19] Table 4 shows the comparison of the results of the different studies.

Table 4: Comparison of the studies using pedometer determined physical activity

Author	Subjects	Males (mean steps/day)	Females (mean steps/day)
Our study	168 students (90 males and 78 females)	10,933.2 ±4,189.5	**8307.5 ±4,767.5**
Duncan et al 2008[11]	513 girls aged 5–16 Auckland, New Zealand		**n = 231 Gr 7 -8 Weekday 11,882 ± 3,288 Weekend: 7,514 ± 3,050 n= 650 Gr 9 -10 Weekday: 11, 537 ± 3,567 weekend : 8,812 ± 4,423**
Hohepa et al 2008[17]	236 students aged 12–18 Auckland, New Zealand	10,849 ± 381	**9,652 ± 289**
Raustorp et al 2007[18]	46 boys and 51 girls from 2000 - 2005 Sweden	age 12.5 15,663 ± 3,683 age 15.5 11,499 ± 2,954 age 17.5 11,398 ± 3783	**age 12. 9 13,276 ± 2,818 age: 15.9 12,787± 2,614 age 17.9 12,286 ± 3,523**
Wilde et al 2004[12]	**369 students (179 males and 190 females)from Gr 9 -12 United Sates of America**	**Gr 9 -12 range: 11,564 ± 2,884 to 10,329 ±3,409**	**Gr 9 -12 range: 10,717 ± 3,342 to 9,643 ± 3,039**

Our study also showed that students were more active during weekdays than weekends, which is similar to the research of Duncan and Hohepa.[11,17] According to a study done by Guirindola on Filipino children, a greater proportion of children performed sedentary activities on weekends such as watching TV and playing video games.[20] This highlights the need of creating strategies that will encourage adolescents to be more active during weekends. However, the importance of the school setting in promoting physical activity could not be discounted.

Similar to other studies, our result shows that males are more active than females, but did not show any difference in mean pedometer steps with the different age groups which was similar to the study of Wilde[3,12,22-24] Wilde investigated the mean pedometer counts of 369 students from Grades 9 to 12. The result showed that there was no difference in the mean pedometer count from the different grade levels except for Grades 10 and 12 where the participants in Grade 10 had a higher mean steps per day than Grade 12. The males accumulated more steps per day than females did at all grade levels. While the study by Duncan of girls in Auckland showed that the participants in school years 9–10 achieved 2,469 (weekday) and 4,011 (weekend) fewer steps than girls in years 1–2.[11] The inconsistent results of the correlation of age with physical activity have been reviewed by Sallis of 104 studies.[2] In adolescents, males being more active than females was the most consistent supported finding, which was positive in 27 out of 28 comparisons, while age which had a negative association with physical activity was found in 70% of the 27 comparisons.

Our study also showed that walking to school, being an athlete, and body mass index were variables that were not associated with the mean pedometer count using multivariate analysis. Walking to school has been closely related to improving physical activity in adolescents and children.[11,17] In our study, this associative factor was not significantly correlated to the total mean pedometer steps and weekday mean pedometer steps. The school where the research was carried out is located in an urban setting where the usual mode of transport to school is by public transportation and private cars. There was also a possibility that only those students who lived in close proximity to school were the ones who walked to school, which did not significantly affect the mean pedometer count. It is important to note that a nominal percentage of students walk to school (8.9% and 12.8% of males and females, respectively).

The results showed that body mass index was not associated to the mean pedometer count. The review of Sallis demonstrated that the correlation between physical activity level and adolescent body weight was indeterminate.[2] But recent studies which correlated obesity measured by percentage body fat and physical activity using accelerometers showed that more involvement in vigorous physical activity was associated with a lower percentage of body fat.[23,24] Although we used pedometers, which are objective measures of physical activity, one of the shortcomings is that it could not quantify the intensity of physical activities into light, moderate, or vigorous. This could be a possible explanation why there was no correlation between body mass index and physical activity.

Surprisingly, being an athlete was not a significant factor affecting pedometer steps when using multivariate analysis. A study by Ekuland assessed the total amount of physical activity in adolescent athletes using CSA activity monitors.[25] They concluded that the relationship between activity counts and total daily energy expenditure is affected by different training conditions, whether it is pre-season, in-season, or off-season training. And these circumstances should be carefully considered in the interpretation physical activity. The authors were not able to ascertain whether the participants who were athletes were in pre- season, in season, or off season during the duration of the study.

CONCLUSION

Because of the association of physical inactivity and decreased physical fitness in the development of cardiovascular disease risk factors not only in adults but also in children and adolescents as well, strategies should be implemented in order to assure that children and adolescents will be encouraged to be participate more in physical activity. This, in effect, will decrease the economic burden of the increasing morbidity of cardiovascular diseases in the Philippines.

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