

AN INVESTIGATION STUDY ON THE ASSOCIATION BETWEEN SCHOOL DAILY STEPS COUNT AND HEALTH RELATED INDICATORS IN CHILDREN

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Abstract

The aims of this study were: (1) To assess step counts during school day hours (2) to assess and compare by gender Body Mass Index, waist circumference, body fat percent in children aged 10 yrs in Tirana, and (3) to investigate the association between pedometer steps count with Body Mass Index, waist circumference and body fat percent. One hundred and twenty seven Albanian primary school children aged 10 years (9.9 yrs, SD 0.4) wore a pedometer for two consecutive school days in 2012, had their body height, body weight and waist circumference measured, and body fat percent by skin fold measurement calculated. Independent t test revealed that boys and girls did not have any significant differences in all health related variables assessed in this study. Boys were more active ($p= 0.00$) than girls during school day hours. The mean number of steps for boys was 1341.5 (SD 545.7) and for girls 772.2 (SD 452.4) steps. There was a significant negative relationship between steps with waist circumference in boys ($r= -0.33$, $p= 0.01$) and between steps and body fat percent in boys ($r= -0.32$, $p= 0.02$). This study demonstrates a negative relationship between school daily steps counts and body fat percent and waist circumference in boys 10 years of age.

Key words: physical activity, steps, BMI, waist circumference, body fat percent

Introduction

Obesity has become an epidemic, not just in Europe, but also across the globe. Obesity is a result of many factors including poor dietary habits, inadequate physical activity, hormonal issues, and sedentary lifestyle, as well as many psychological issues. Direct and indirect costs associated with obesity-related morbidity and mortality have been estimated to be in the billions of dollars (Shankar et al., 2013). Insufficient physical activity among young people aged 5-18 years is a global public health issue, with considerable disparities among countries. The need to understand where and how much physical activity (PA) children accumulate has become important in assisting the development, implementation, and evaluation of PA interventions. Children's current physical activity levels are disturbingly low when compared to recommended levels. This may be changed by intervening in the school environment. However, at

present, it is unclear to what extent schoolyard physical activity contributes towards reaching the daily physical activity guideline (Dessing et al., 2013). To provide the recommended levels of physical activity for children in school, the available physical space environment is an important area of focus for advocates of physical activity recommendations within the school environment (Leng and Lessard 2013).

The school environment seems to be an important setting for improving children's physical activity levels. Further research on the facilitators of these high activity levels may provide targets for further promotion of physical activity among children. It is well established that the risk of insufficient physical activity is greater in girls than in boys, especially during the adolescent years. The results from the study of Cox et al., 2006, suggest that physical activity outside of the school environment is a key contributor to a child's overall level of physical activity, reinforcing the need for interventions

targeting the family and community as well as the school environment. The aims of this study were to: to assess step counts during school day hours; to calculate body mass index; to assess waist circumference, body fat percent in Albanian children aged 10 yrs, and to compare this variables by gender ; to investigate the correlation between pedometer steps count with Body Mass Index, waist circumference and body fat percent.

Methods and results

Participation in the study

A total of 127 children aged of 10 years (mean 10.9 yr, sd 0.4) from fifth elementary school (58 boys and 63 girls), respectively, participated in this study. Two elementary schools were randomly selected from a pool of 57 elementary school (Regional Education Directorate of Tirana 2013) located in Tirana. Although there is a small number of children selected and not be a representative for Tirana city. For each participant, informed consent was signed by both the parents and the school directorial. The measurements of the children were conducted by a group of examiners in the selected schools (in two weeks).

Body Height and weight were measurement to BMI calculation. It was measured waist circumference and was calculated body fat percent by skin fold thickness measurement. The equation described by Slaughter et al. (1988) were used to predict body fat percent. In order to investigate the school daily step counts children wore a pedometer for two consecutive days and the mean values between two days were used for the data calculation (from 8 00- till 13 00).

Assessment

Three measurements were used as health related variables: body mass index (BMI), body fat percent and waist circumference.

Anthropometric measures

Body height and body mass were measured. BMI was calculated using usual formula ($\text{kg}=\text{m}^2$).

Procedure: Standing height is the measurement the maximum distance from the floor to the highest point on the head, when the child is facing directly ahead. Shoes should be off, feet together, and arms by the sides. Heels, buttocks and upper back should

also be in contact with the wall when the measurement is made. To assess body weight the child is weighted standing on the weight with minimal movement with hands by his side. Shoes and excess clothing should be removed. Participants were asked to stand with back, buttocks, and heels against the stadiometer, with their feet together and flat on the floor and their head straightened in a neutral position. Body mass was measured in minimal clothing and to the nearest 0.1 kg. BMI was calculated directly as $\text{weight (in kilograms)}/ [\text{height (in meters)}]^2$

Waist Circumference measurement

Procedure: The waist circumference were measured at the part of the trunk located midway between the lower costal margin (bottom of lower rib) and the iliac crest (top of pelvic bone) and was measured to the nearest 0.5 cm, at the end of a normal

Body fat percent calculation

To predict body fat percent, skin fold thickness measurement was used (Slaughter et al., 1988).

Procedure: Triceps and sub scapular skin folds thickness were measured to the nearest 0.2mm using a calliper (Harpenden, St. Albans, UK) on the right side of the body. All skin folds were taken three times by the same experimenter to ensure consistency in results with the average of the three values used as a final value. To predict body fat (% FM) the equation described by Slaughter et al. (1988) were selected. Equipment required: Caliper

Steps count measurement

Procedure: All children wore a pedometer for two consecutive school days from morning (8 00) until (13 00). This time represent the school hours. The average steps count between two consecutive days were used in the analysis. Equipment required: Pedometer steps count

Statistical analysis

Summary statistics for all variables are were provided in the results section of this study. In depended t test was employed to test whether there were significant differences between gender for health related indicators and school daily steps count. All variables were tested for normality.

Pearson correlation test were used for association between steps counts and health related indicators (univariate). Linear regression analyzing were used to investigate the relationships between steps counts (independent variable) with health related components (depended variable). P-values of 0:05 were considered statistically significant. All analysis was per-formed using the statistics system SPSS 17.0.

Results

A total of 127 children in fourth grade elementary school (62 boys and 65 girls) aged 10 years old) were enrolled in this study (see Table 1 for gender and age SD).

Table 1: Descriptive statistics for children participated in the study

gender	N	age/ yrs Mean	Std
total	127	9.9	0.4
boys	62	10.0	0.4
girls	65	9.8	0.4

Table 2 presents main descriptive statistics (mean scores and standard deviation) for the health related variables (body mass, body height, BMI, waist circumference, percent body fat and pedometer steps count) while table 3 presents gender comparison data using independent samples t test.

Table 2: Mean and std for variables assessed in this study by gender.

Variables		Total		Boys		Girls	
		Mean	Std	Mean	Std	Mean	Std
weight	kg	37.2	8.7	38.7	8.9	36.0	8.4
height	m	1.40	0.1	1.41	0.1	1.40	0.1
BMI	kg/m2	18.7	3.3	19.3	3.6	18.3	3.1
waist	cm	67.0	9.8	68.8	10.0	65.7	9.6
body fat	%	19.4	7.8	19.6	9.2	19.3	6.6
pedometer	steps	1027.7	570.3	1341.5	545.7	772.2	452.4

Significant gender differences (P ≤ 0:05) were found for steps where boys had higher steps count than girls (boys-1341.5 steps SD-545.7 and girls- 772.2 steps SD-452.4). Both genders did not have significantly different scores on body height, body weight, waist circumference and body fat percent values.

Table 3: Gender comparison- Independent Samples t Test (95% CI).

	t	df	p	Mean Diff	Std. Error Diff
weight	1.77	124	0.08	2.73	1.55
height	1.46	124	0.15	0.02	0.01
BMI	1.58	124	0.12	0.94	0.60
waist	1.76	123	0.08	3.09	1.76
body fat	0.16	121	0.87	0.23	1.42
pedometer	6.43	125	0.00	569.36	88.56

P values refer to comparison between boys and girls for variables assessed.

Results shows that the average steps are 1027.7 (boys- 1341.5 steps, girls- 772.2 steps). Statistical analysis show significant differences. Data from the table 4 present association between physical activity (pedometer) and health related indicators by gender. Results show a weak negative association between physical activity (pedometer) and health related indicators in children (both boys and girls). While splitting the results by gender, the analysis show a weaker negative correlation in girls and stronger correlation in boys (pedometer with BMI r=-0.22, p= 0.11; pedometer with waist r=-.330,p= 0.01; pedometer with body fat p=-.323, p=0.02).

Table 4: Association between physical activity (pedometer) and health related indicators by gender.

			BMI	waist	body fat
total	pedometer	r	-0.08	-0.07	-0.15
		p	0.39	0.43	0.09
boys	pedometer	r	-0.22	-0.330	-.323
		p	0.11	0.01	0.02
girls	pedometer	r	-0.12	-0.01	0.01
		p	0.34	0.93	0.97

Correlation is significant at the 0.05 level (2-tailed).

Results from table 5, show data analysis from the regression analysis between pedometer measured by steps count during school day and body fat % for boys. In this analysis it was used pedometers steps as an independent variable (predictor) and body fat % as an depended variable. This descriptive statistics show body fat percentage (19.6 %) and pedometer step counts (1353.6 steps). Table 6 provides the R and R2 value. The R value is 0.32, which represents the simple correlation. It indicates a medium degree of correlation. The R2 value indicates how much of the dependent variable, "body fat", can be explained by the independent variable, "pedometer". In this case, 10.4% can be explained. The table 7, (coefficients), provides us with information on each predictor variable. We can see that both the constant and body fat percent contribute significantly to the model (by looking at the Sig. column). By looking at the B column under the Unstandardized Coefficients column, we can present the regression equation as: Body fat percent= 26.82 -0.005 (pedometer steps count)

Table 7: Coefficients from regression analysis (pedometer with body fat %) for boys

Model	Unstand Coef		Stand Coef		
	B	Std. Error	Beta	t	Sig.
(Const)	26.82	3.152		8.51	0
pedom	-0.005	0.002	-0.32	-2.48	0.02

a. gender = boys

b. Dependent Variable: body fat %

Table 5: Descriptive statistics for regression analysis (pedometer with body fat %) for boys.

	Descriptive Statistics(a)		
	Mean	Std. Deviation	N
body fat %	19.6	9.2	62
pedometer	1353.6	551.5	62

a.gender=boys

Table 6: Coefficient of determination from regression analysis (pedometer with body fat %) for boys

	Model Summary			
	R	R Square	Adj Square	R Std. Error
a. Predictors: (Constant), pedometer	0.32	0.104	0.087	8.7504
b. Dependent Variable: body fat %				

Results from table 8, show data analysis from the regression analysis between pedometer measured by steps count during school day and waist circumference for boys. In this analysis it was used pedometers steps as an independent variable (predictor) and waist circumference as an depended variable.

Table 8: Descriptive statistics for regression analysis (pedometer with waist circumference) for boys

	Descriptive Statistics(a)		
	Mean	Std. Deviation	N
waist	68.754	9.9938	62
pedometer	1333.34	547.122	62

a.gender=boys

Table 9 provides the R and R² value. The R value is 0.33, which represents the simple correlation. It indicates a medium degree of correlation. The R² value indicates how much of the dependent variable "waist circumference", can be explained by the independent variable, "pedometer". In this case, 10.9% can be explained. but not meaningful..

The table 10, (coefficients), provides us with information on each predictor variable. This gives us the information we need to predict waist circumference from pedometer steps count. We can see that both the constant and waist circumference contribute significantly to the model (by looking at the Sig. column). By looking at the B column under the Unstandardized Coefficients column, we can present the regression equation as: waist circumference = 76.79 -0.006(pedometer steps count)

Table 9: Coefficient of determination from regression analysis ((pedometer with waist circumference) for boys

Model	Model Summary			
	R	R Square	Adjusted R Square	Std. Error
	0.330 a	0.109	0.092	9.521

a. Predictors: (Constant), pedometer gender = boys
 Dependent Variable: waist

Discussion and conclusion

Independent t test revealed that boys and girls did not have any significant differences in the health related variables assessed in this study. Boys were more active (p= 0.00) than girls during school day hours. The mean number of steps for boys was 1341.5 (Sd 545.7) and for girls 772.2 (SD 452.4) steps.

Pedometers differentiate among age groups and gender concerning physical activity and facilitate individual goal setting (Raustorp et al., 2004). The result of this study provide baseline information, useful as reference data, on youth physical activity as daily step counts, as well as on youth BMI levels according to new international cut-off points.

There was a significant negative relationship between steps with waist circumference in boys (r= -0.33, p= 0.01) and between steps and body fat percent in boys (r= -0.32, p= 0.02).

In conclusion this study demonstrates a negative relationship between school daily steps counts and body fat percent and waist circumference in boys aged 10 years of age telling that physical activity is an important factor in avoiding overweight an obesity.

The study of Cuddihy et al., (2006) revealed that a significant drop-off in pedometer-determined mean daily steps occurred at grade ten, or approximately 15 years of age. A significant inverse relationship between mean daily steps and BMI was found (r = -.251, p<.0001).

Table 10: Coefficients from regression analysis ((pedometer with waist circumference) for boys

Model	Unstan Coef		Coef		
	B	Std. Error	Beta	t	Sig.
(Constant)	76.79	3.377		22.736	0
pedometer	-0.006	0.002	-0.33	-2.569	0.013

a. gender = boys

b. Dependent Variable: waist

The study also revealed negative correlations between BMI and all self-perceptions ($p < .05$), except strength, which showed a positive correlation ($p < 0.05$). A positive correlation was found between level of physical activity and all self-perceptions, except Global Self-Worth, which showed no significant difference.

Cardon and De Bourdeaudhuij (2007) in their study found that daily step counts in preschool children give valid information on physical activity levels, and were strongly correlated ($r = 0.73$, $p < .001$) with MVPA minutes. The results show that boys took significantly more steps/day than girls during most PA opportunities; especially in school hours, $t(811) = 10.61$, $P < .01$ (Brusseau et al., 2011). Data from the study of Colley et al. (2012) showed that 12,000 steps per day can be used as a target to determine whether children and youth age 6-19 yr are meeting the current physical activity guideline of 60 min of daily MVPA. The results from the study by Adams et al. (2013) show that no single study has definitively identified a precise and unyielding steps/day value for youth. In the study of Cox et al. (2006), at a New Zealand the authors found that mean daily steps for the overall sample were 14 333 steps. Boys (15 606 steps) were significantly more active than girls (13 031 steps) ($p = .00$). Mean steps were also significantly higher in older age groups for both boys ($p = .03$) and in particular, girls ($p = .00$). While a significant difference was found between the most and least active tertiles in steps taken during both during school hours ($p = .00$) and outside of school hours ($p = .00$), the most active third of the sample completed significantly more of their daily steps outside of school (55.1%) than did their least active (46.7%) counterparts ($p = .00$).

Data from the study of Duncan et al., (2007) showed that overweight children had significantly lower mean step counts (14,238+/-3343, boys; 12,555+/-3169, girls) than non-overweight children (16,106+/-3208, boys; 14,176+/-2728, girls). Optimal step count cut-off points were 16,000 steps/day for boys and 13,000 steps/day for girls.

This study represent the first data for the steps counts In children in Albania. From our point there are no published data from studies performed in Albania retarding using steps counts in children It is recommended that standardized wear time criteria are established for different age groups, and that wear times are reported. As activity varies between weekdays and weekend days, researchers interested in habitual activity should include both types of day in surveillance studies. Even though two elementary schools were randomly selected from a pool of 57 elementary school located in Tirana, the children participating in the study are not representative for Tirana, which makes the study quite weak. representing the entire population of children in Tirana.

References

Anders Raustorp, Robert P Pangrazi, Agneta Ståhle (2004), Physical activity level and body mass index (BMI) among schoolchildren in south eastern Sweden, *Acta Paediatrica* 93(3):400-4, DOI, 10.1080/08035250310007484

Adams M A, Johnson W D and Tudor-Locke C (2013). Steps/day translation of the moderate-to-vigorous physical activity guideline for children and adolescents., *Int J Behav Nutr Phys Act* 10, 49.

URL: <http://dx.doi.org/10.1186/1479-5868-10-49>

Brusseau T A, Kulinna P H, Tudor-Locke C, Ferry M, van der Mars H and Darst P W (2011). Pedometer-determined segmented physical activity patterns of fourth-and fifth-grade children., *J Phys Act Health* 8(2), 279–286.

Cardon G and De Bourdeaudhuij I (2007). Comparison of pedometer and ac-celerometer measures of physical activity in preschool children., *Pediatr Exerc Sci* 19(2), 205–214.

Colley R C, Janssen I and Tremblay M S (2012). Daily step target to measure adherence to physical activity guidelines in children., *Med Sci Sports Exerc* 44(5), 977– 982.

URL: <http://dx.doi.org/10.1249/MSS.0b013e31823f23b1>

Cox M, Schofield G, Greasley N and Kolt G S (2006). Pedometer steps in primary school-aged children: a comparison of school-based and out-of-school activity., *J Sci Med Sport* 9(1-2), 91–97.

URL: <http://dx.doi.org/10.1016/j.jsams.2005.11.003>

Dessing D, Pierik F H, Sterkenburg R P, van Dommelen P, Maas J and de Vries S I (2013). Schoolyard physical activity of 6-11 year old children assessed by GPS and accelerometry., *Int J Behav Nutr Phys Act* 10, 97.

URL: <http://dx.doi.org/10.1186/1479-5868-10-97>

Duncan E K, Scott Duncan J and Schofield G (2008). Pedometer-determined physical activity and active transport in girls., *Int J Behav Nutr Phys Act* 5, 2.

URL: <http://dx.doi.org/10.1186/1479-5868-5-2>

Duncan J S, Schofield G and Duncan E K (2007). Step count recommendations for children based on body fat., *Prev Med* 44(1), 42–44.

URL: <http://dx.doi.org/10.1016/j.yjmed.2006.08.009>

Duncan MJ, Nevill A, Woodfield L, Al-Nakeeb Y. (2010) The relationship between pedometer-determined physical activity, body mass index and lean body mass index in children. *Int J Pediatr Obes.* Oct;5(5):445-50. doi: 10.3109/17477160903568421.

Leng S W and Lessard L (2013). Family child care providers' compliance with state physical activity regulations, Delaware Child Care Provider Survey, 2011., *Prev Chronic Dis* 10, E114.

URL: <http://dx.doi.org/10.5888/pcd10.120295>

Shankar P, Ahuja S and Sriram K (2013). Non-nutritive sweeteners: Review and update., *Nutrition* .

URL: <http://dx.doi.org/10.1016/j.nut.2013.03.024>

Slaughter M H, Lohman T G, Boileau R A, Horswill C A, Stillman R J, Van Loan M D and Bembien D A (1988). Skinfold equations for estimation of body fatness in children and youth., *Hum Biol* 60(5), 709–723.