CARDIOLOGIE TUNISIENNE

Activité physique et composition corporelle chez les adolescents en surpoids et obèses du secondaire à Sfax (Tunisie)

Physical activity and body composition among secondary school adolescents with overweight and obesity in Sfax (Tunisia)

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Summary

Background: Little data exists describing the associations between physical activity, as assessed by pedometer and the fatness measures ,of overweight and obese adolescents in developing countries.

Subjects and Methods: Overall, 153 adolescents aged 15-18 years were included in the study. Demographic information was recorded. Weight, height, waist circumference, and Body Fat Percentage (BFP) by Skinfold Thickness were evaluated. Participants wore a pedometer (YamaxDigiwalker SW-200) for 7 consecutive days.

Results: Boys accumulated 9134.3±2688.78 steps/day and girls accumulated 8231.64±2357.55 steps/day. Participants were less active on weekend days (6363.80±2347.95 steps/day) and more active on Physical Education (PE) days (10714.40±2946.20 steps/day). Boys had significantly more steps counts on PE days compared to the girls (p=0.04).

The daily step count was inversely associated with the BFP for both boys and girls. However, it was inversely associated with the Body Mass Index (BMI) and Waist Circumference only 1in girls (p < 0.05).

Conclusion : Low levels of steps/day increase the likelihood of having more fatness among overweight and obese adolescents. Efforts to increase walking may decrease the likelihood of developing disease risk factors.

Résumé

Introduction : Il existe peu de données dans la littérature qui s'intéressent à l'association entre le degré de l'activité physique, évaluée par un podomètre, et la masse grasse, chez les adolescents en surpoids et obèses dans les pays en développement.

Patients et méthodes: Notre étude a concerné 153 adolescents âgés de 15 à 18 ans. On a évalué le poids, la taille, le tour de taille et la masse grasse par le calcul de l'épaisseur du pli cutané. Tous les participants ont porté un podomètre (YamaxDigiwalker SW-200) pendant 7 jours consécutifs.

Résultats: Les garçons ont effectué 9134,3±2688,78 pas/jour par rapport à 8231,64±2357,55 pas/jour chez les **filles**. Tous les participants étaient moins actifs les jours de week-end (6363.80±2347.95 pas/jour) et plus actifs les jours d'éducation physique (10714.40±2946.20 pas/jour). Les garçons avaient significativement plus de nombre de pas les jours d'éducation physique par rapport aux filles (p=0,04).

Le nombre de pas quotidiens était inversement associé au pourcentage de graisse corporelle pour les garçons et les filles. Il était ainsi inversement associé à l'indice de masse corporelle et au tour de taille uniquement chez les filles (p <0,05).

Conclusion: Un nombre réduit de pas/jour prédispose à une masse grasse plus importante chez les adolescents en surpoids et obèses.

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INTRODUCTION

The sedentary lifestyle imposed by modern civilisation becomes an important factor influencing health state in both developed and developing countries (1,2). In fact, low levels of Physical Activity (PA) are associated with an increased risk for adverse physiological outcomes including obesity, cardio vascular diseases (CVD) and diabetes mellitus (3). So, the need to understand how much youth PA accumulates has become increasingly important in the development and evaluation of interventions targeting PA (4). It is especially important for overweight and obese adolescents who usually have lower overall physical abilities and lower cardiorespiratory fitness (CRF) with higher risk to develop CVD and Type 2 diabetes when compared to their normal weight peers (3,4).

PA can be evaluated by a variety of objective measures. The pedometer has become one of popular tools for measuring PA ,due to its low cost and easy use (5).In addition, it provides an accurate and reliable assessment of the amount of activity in which overweight and obese adolescents engage (5,6).But, the fluctuations of day to day PA levels are less understood (7) Several recent studies noted that levels of PA of adolescents may fluctuate by day of week (weekdays/weekends), type of day (Days with PE lessons /Days without PE lessons) and by sport/exercise participation (7,8).Similarly, it was noted that it will be necessary to take into consideration the age range, gender and weight status of participants (8,9).The level of PA assessed by pedometer of overweight and obese adolescent is poorly understood in Tunisia. Therefore, the purpose of this study was to describe daily pedometer-determined PA patterns of overweight and obese adolescent pupils (15-18 years).The purposes of our study were to :

1- Appraise the variability of PA levels of these pupils according to days with PE lessons, days without PE lessons and weekend days.

2- Assess the associations between their PA levels (measured by pedometer) and fatness.

SUBJECTS AND METHODS

Study sample

Our population was selected among 400 pupils with overweight and obesity from secondary school Majida Boulila in Sfax city (located at the South-East of Tunisia) during the school year 2014-2015.

This sample was recruited from a school–based cross–sectional study conducted by the Unit of Obesity and Metabolic Syndrome, Department of Endocrinology, HediChaker Hospital Sfax and designed to examine the prevalence of metabolic syndrome among adolescent swith overweight and obesity and to assess its association with PA.

The present study was approved by the Ministry of Education and the Ethics Committee of HediChaker Hospital, Sfax, Tunisia.

Students were informed about the study aims. All participants and their parents provided written informed consent.Participants did not receive any incentives and could withdraw from the study at any time.

Inclusion criteria were students between the ages of 15 and 18 years, with a Body Mass Index (BMI) above or equal to the value that predicted overweight or obesity by applying the age and sex specific International Obesity Task Force (IOTF) BMI cut off points (10) and without orthopedic disease or injury that could limit PA.

A total of 180 adolescents with overweight and obesity were randomly selected according to the weight status, age and sex to participate in the study. Complete data were obtained from 153 pupils (84 girls and 69 boys). The exclusion criteria were adolescents that were severely sick during the time of the study or did not complete all parts of the study.

Data collection

All measurements were conducted in the school clinic and performed by the school nurses. Anthropometric standardization exercises were conducted to ensure uniform techniques. All participants went through physical examination including anthropometric assessments.

Anthropometric measurements

Weight was measured without shoes and heavy clothes using a Tanita electronic scale (Tanita BF 571, Tanita Corporation, Japan) .Standing height was measured with a suspended Microtoise tape to the nearest 0.1 cm. BMI was calculated as weight in kilograms divided by the square of height in meters (kg/m²).The adolescents were classified as with overweight/obesity based on the age and sex IOTF BMI cut off points.

Waist circumference (WC) was measured in cm with a non-elastic tape at a point midway between the lower border of the rib cage and the iliac crest at the end of normal expiration.

Hip circumference (HC) was measured in cm at the greater trochanter of the femur with the legs close together using a non-stretchable measuring tape and the Waist to Hip ratio

(WHC) was calculated by dividing WC with HC.

Skinfold thicknesses (SFT) were measured at 4 sites: triceps, biceps, subscapular and suprailiac by a trained examiner using a Harpenden Skinfold Caliper (Holtain Ltd, Crosswell, UK) (11,12).

For the triceps, the midpoint of the back of the upper arm between the tips of the olecranal and acromial processes was determined by measuring with the arm flexed at 90°.

Over the biceps, the SFT was measured, at the same level as triceps skinfold, directly above the center of the cubital fossa with the arm hanging freely and the palm facing outwards.

The suprailiac SFT was measured about 20 mm above the iliac crest, just posterior to the midaxillary line and parallel to the cleavage lines of the skin.

Each SFT was measured in duplicate on the right side of the body, and the mean value was used for calculation. Body density (BD) and BFP were calculated according to the following equations from Deurenberg et al (12).

Physical activity level evaluation

The YamaxDigiwalker SW-200 pedometer was used to monitor the adolescent daily PA. This model of pedometer has produced valid and reliable scores in measuring adolescent PA (13).

The pedometer protocol was adopted from previous research (13-17). Prior to data collection, a pedometer training session was conducted for PE teachers, in order to familiarize their students with the protocol. All batteries were changed and each participant completed an individualized 20-step pedometer calibration to assess the functional status of each pedometer. Participants were instructed to place the pedometer on the right side of the body attached to either a belt or waistband on the anterior midline of the thigh. Pedometers were worn during all waking hours, except when bathing or swimming, and removed prior to going to sleep at night. The inclusion criteria was a pedometer recording of at least 10 h per day, for 7 days, of which one had to be a weekend day.

The participants recorded their daily step counts undertaken during each school day (Days with PE lessons and Days without PE lessons) and weekend days. Similarly, adolescents completed Previous Day's Activity Surveys daily to check for accuracy of values and compliance with wearing the instrument (15).In fact, pupils recorded the time spent in each activity to the nearest 10 minutes. The data for the pedometer counts were examined and outliers of less than 1000 and more than 30,000 steps were removed (16).

Statistical analysis

All statistical analyses were performed using the software Statistical Product and Service.

Solutions (version 15.0 SPSS Inc., Chicago, IL, USA), and the level of significance was set at P value of <0.05. Descriptive characteristics were summarized by sex. Quantitative variables were expressed as mean-standard deviation. Qualitative variables were expressed as number and percentage. For continuous variables, the differences were evaluated using an unpaired t test. Categorical variables were assessed using chi-squared test. The correlation between pedometer steps counts and body composition were assessed using Spearman's correlation.

RESULTS

A total of 153 adolescents with overweight and obesity, living in Sfax (Tunisia) participated in this study. The proportion of females was 54.9%. According to (IOTF) BMI cut off points, 37.3 % of subjects were overweight and 62.7% obese. All subjects in our study participate in physical education classes (two one-hour sessions per week) and only 3 boys enrolled in structured PA outside school.

The mean age of adolescents was 16.74±0.71 years. There were 54 adolescents who were between 15 to 16 years and 99 between 16 and 18 years. Descriptive characteristics of the sample are shown in table 1.

Tableau 1. Descriptive (Mean and standard deviations) of anthropometric and PA measurements with pedometer in Tunisian Adolescents with overweight or obesity

	Total (N=153) Mean ± SD/ n (%)	Girls (n=84) Mean ± SD/ n (%)	Boys (69) Mean ± SD/ n (%)	p-value
Age (years)	16.74±0.71	16.80±0.75	16.70±0.60	0.6
Weight status n (%)				
Obese	96 (62.8)	42 (50)	54 (78.3)	0.03
Overweight	57 (37.2)	42 (50)	15 (21.7)	
weight (kg)	90.74±18.4	83.10±12.85	99.45±17.84	0.001
Height(cm)	169.4±8.8	164.55±6.22	174.3±7.75	0.000
Body mass index (kg/m²)	31.45±4.21	30.75±4.4	32.55±4.75	0.11
Waist circumference (cm)	95.45±13.1	89.8±8.6	102.12±14.10	0.00
Hip circumference (cm)	106.57±12.53	106.34±9.21	107.53±12.41	0.7
Waist to hip ratio	0.89±0.09	0.84±0.06	0.95±0.075	0.00
% Body Fat	37.30±3.89	38.01	36.43±3.68	0.15
Steps/day	8755.88 ± 227.75	8231.64± 2357.55	9134.3± 2688.78	0.09

Males were significantly heavier (99.45±17.84 vs. 83.10±12.85 kg, p< 0.01) and had a higher WC (102.12 vs. 89.8 cm, p< 0.001) and WHC (0.95 vs. 0.84, p< 0.001) compared to females. The average step count was 8755.88 ± 227.75 steps/day (9134.3±2688.78 steps/day for boys and 8231.64±2357.55 steps/day for girls; p = 0.07).

Our results demonstrated that the highest numbers of steps/day were on school days compared to weekend days. The participants accumulated 6363.80±2347.95 steps/day on weekend day (6881.22±2820.24 steps/day for boys and 5939.79±1737.32 steps/day for girls; p = 0.09) and 10714.40±2946.20 steps/day on PE days (11400± 2765.40 steps/day for boys and 10151.2±2532.87 steps/day for girls; p=0.04).

Table 2 shows the results of grouping the sample into the most and the least active groups, based on the upper and lower 50th percentiles of pedometer-determined steps counts.

Tableau 2. Mean and standard deviations of steps /day, age, Body mass index, Waist circumference, Waist to hip ratio and BFP

Characteristics	Pedometer steps counts percentiles		p-value
	<50th means± SD	>50th means± SD	
Steps/Day	7314.88± 1472.79	10926.27 ±1486.33	0.001
Age (years)	16.96 ± 0.68	16.65±0.69	0.11
Body mass index (kg/m²)	32.16±4,07	30.41 ±2.8	0.08
Waist circumference (cm)	97.88±13.95	92.58 ±9.59	0.11
Waist to hip ratio	0.91±0.99	0.88±0.77	0.3
Body fat percentage (%)	39.650 ±3.52	35.11 ±3.01	0.001

Note: standard deviations =SD

Participants who accumulated < 50th percentiles of pedometer-determined steps counts had a higher occurrence of BFP compared to the most active who accumulated ≥50th percentiles. The relationship between pedometer steps counts and anthropometric parameters are presented in Table 3.

Tableau 3. Correlations (Spearman correlation) of accumulated Steps per Day with anthropometric parameters of Tunisian adolescents

	Boys	Girls	Total
Body mass index (kg/m2)	-.199	-.434*	-.263*
Waist circumference (cm)	-.083	-.339*	-.133
Waist to hip ratio	-.194	-.207	-.018
Body fat percentage (%)	-.515*	-.704**	-.644**

p value : *=p <0.05 ; **= p<0.01 ;*** =p <0.001

Pedometer steps counts were negatively correlated with the BFP for both sexes. However, the daily step counts were inversely associated with the BMI and WC, only in girls with (r = - 434; p < 0. 05 and r = - 339; p < 0.05 respectively).

DISCUSSION

To the best of our knowledge, the study described in this paper could be the first to assess levels of PA by pedometer (daily steps counts) of Tunisian adolescent pupils.

Based on the results of the pedometer step counts reported in the present study, it appears that a large proportion of the participants were generally somewhat active and that the daily step counts was inversely associated with the BFP.

In fact, the mean steps/day of 9134.3 for boys and 8231.64 for girls suggest that our sample group falls a little lower than 10,000 steps/day. The well-known criterion of 10000 steps per day is indicative of an active adult lifestyle, but is likely too low for children and approximates meeting the PA guidelines for adolescents, especially girls (9,17,18). The mean pedometer values recorded for the present study are lower than those reported by Hands et al. (8) for their subsample of (164 boys and 205 girls) overweight and obese young Australian who were between 7 and 16 years old (boys 12920 steps/day and girls 10217 steps/day).

Children and adolescents with overweight or obesity have fewer steps per day and took somewhat fewer steps/ minute than those with normal weight (4,17) .Gillis et al.(19) found that children with obesity and who were between 4 and 16 years spent less time engaged in moderate and vigorous activity than those with acceptable weight .Laurson et al.(20) noted that for boys 13666 steps/ day and for girls 9983 steps/ day produced the optimal sensitivity and specificity for discriminating overweight and obese versus normal weight status. More recently, Adams et al.(21) have suggested that adolescents with overweight are likely to meet 60-minutes/day moderate-to-vigorous PA recommendations if they accumulate between 10000 and 11700 steps per day.

School physical education (PE) presents a significant role in creating habits for regular PA and acquiring a healthy lifestyle in the lives of children and adolescents (7,8,22).Hence, our results supported the role of

compulsory PE lesson which crucially influence the total PA levels among adolescents with overweight or obesity during each week. In fact, our adolescents were more active in the PE day's (boys 12205 steps/ PE days and girls 10831.1 steps/ PE days).

Our findings supported Brusseau et al ' results (23) that reported that PE day may contribute an additional 1409 and 1011 steps/day for boys and girls, respectively. Further, the published literature suggested strong correlations between the number of times/week that youth participated in PE and self-reported moderate to vigorous PA (22,24).

Nevertheless, our findings are also in accordance with several studies (8, 9) that confirmed the higher level of PA for boys compared to girls. In fact, it is well established that females become even less active once reaching adolescence (25).In addition, the specific character of girls with overweight is probably not respected in the activities offered in PE sessions (26).

Our results demonstrated also that the number of steps at weekends being lower than on school days. In fact, adolescents accumulated on average of 6881.22 and 5939.79 steps/ on weekend day for boys and girls, respectively. This 'high weekdays-low weekends' PA patterns are in agreement with Brusseau et al ' results (23) which demonstrated that obese boys and girls carried out on average 10711 and 9058 steps/days, respectively as opposed to 6554 (boys) and 6874 (girls) on weekend days. Similarly, girls (5-16 years) in New Zealand achieved 11.537 and 8.812 steps on weekdays and weekends respectively (27).A potential explanation for the large difference between weekday and weekend day ,PA may be related to a number of environmental, cultural and socioeconomic determinants. According to Vašíčková et al. (26), the daily responsibilities on school days, active transport and the amount of free-time activities may increase the amount of steps, in comparison with the weekend programme, which was dedicated generally for to rest, watching television, and also preparing for school responsibilities. Low prevalence of PA in Tunisia is due to several factors. For example, only a small number of children and adolescents emphasize extracurricular sports activities. The Fitness clubs are not accessible to all. In addition, public parks and playgrounds are non-existent (1).

Several studies have been devoted to the association between PA and body composition, but the results are inconsistent (8, 27).Our results show that, those accumulating more steps/day had less body fat.

In a meta-analysis investigating the relationship between PA and body fat in children and adolescents, Rowlands et al found a small to moderate relationship which varied depending on the physical activity measure (28).

Further, we documented a similar relationship with BMI and WC in girls, but not in boys. This result concurs with others studies (28, 29), in which activity level was more likely to affect obesity in females than males. Klein-Platat and colleagues explained this finding by the fact that boys are more active than girls and thus more prone to develop lean mass (29).In fact BMI cannot account for variations in the distribution of fat free mass and fat. DiPietro et al (30) confirmed a positive relationship between PA and WC when adjusting on BMI, suggesting a more specific impact of PA on abdominal fat localization. The effects of lifestyle, environmental factors, maturation, heredity and diet are important.

CONCLUSION

The results of our study demonstrated that it appears that a large proportion of Tunisian adolescents with overweight and obesity were generally somewhat active. Further, there is an inverse relationship between pedometer-assessed PA and body composition variables.

The PA levels of participants increases on the PE days and decrease on the weekend. Hence, our findings confirmed the important role of PE in delivering health-enhancing PA.

Thus ,the results of this research serve to encourage physical education teachers to programme more of PE session per week and create extra-curricular PA programmes for adolescents in weekends.

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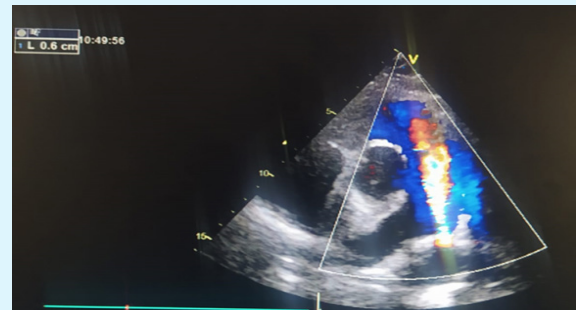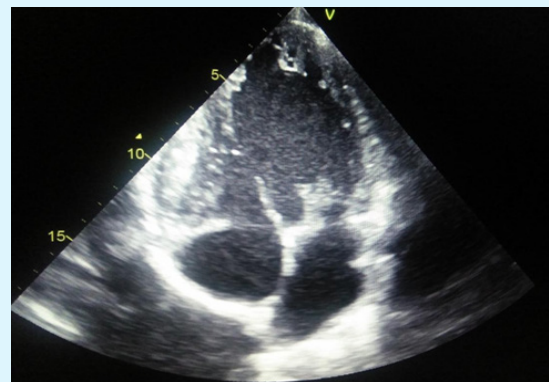
Figure 1. Ductus arteriosus 6 mm wide in a 42-year-old woman
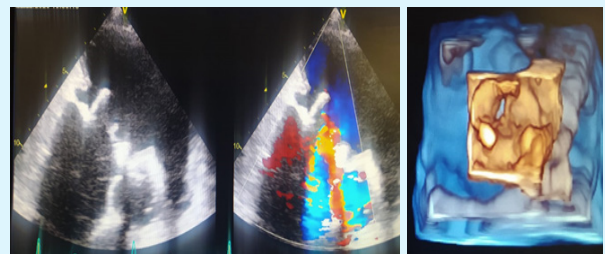
Figure 2. Ebsteine's disease with degeneration of the tricuspid prosthesis which has become stenosing and leaking

Figure 3. Double-inlet single ventricle

Figure 4. L-transposition of the great vessels on double unconformity (DD)