

Physical Activity Level and its Association with Corpulence among Adolescents Attending School from Marrakech-Safi Region (Morocco)

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Abstract

Background: Several studies have examined the association between physical activity and body size globally. However, few researches has focused on this aspect in Morocco. The objective of this study is therefore to explore the level of physical activity and its association with certain anthropometric indicators of corpulence among Moroccan schoolers of Marrakech city and in the province of Al-Haouz.

Methods: A retrospective survey was performed using a questionnaire to examine PA behavior in 1173 high school students, aged 15 to 19 years. Measurements of the respondents' height and weight and body fat percentages using an impedance meter. The PA level was estimated based on the participants' total daily energy expenditure.

Results: The survey data show that students spend, on average, 4 hours per day in front of a screen and only 63 minutes in a sporting activity and that 25% of students are moderately active while 20% are considered to be sedentary active. Averages of body mass index (BMI) and body fat are much higher in the sedentary group compared to the moderately active group, with differences in mean BMI and body fat respectively of 1.24 kg / m² (F = 4.8; p = 0.009) and 1.62% (F = 3.79; p = 0.023) in boys, and 1.33 kg / m² (F = 6.21; p = 0.002) and 2.48 % (F = 3.54; p = 0.03) in girls.

Conclusion: The present study results reveal further evidence of the need to promote physical activity among high school students.

Keywords: physical activity; corpulence; BMI; fat mass; schoolchildren, Marrakesh; Morocco

Introduction

Data on weight status have reported a decrease of underweight while overweight and obesity are increasing globally [1-6] and in different regions including Mediterranean area. In northern Mediterranean countries, the problem of weight excess exists in young people whereas in the southern countries of this area, it is more investigated and prevalent in adults, because of the ongoing nutrition transition. Among the many factors involved the dietary behavior [7, 8] and lifestyle changes including level of physical activity (PA) and to sedentary lifestyles [9-11]. In the last fifty years, studies in this field have become numerous worldwide. However, in Morocco, studies dedicated to this field are currently, to our knowledge, still scarce or totally inexistent, and especially among high school students in the region of Marrakech-Safi. This region is located in the country center, with a surface area representing 5.5% and a population accounting for 13.4% respectively of the national territory and population [12]. Urbanization rate in this region increased to 42.8% [12] in 2014. The total urban area accounts for 73.6% in the region capital (Marrakech city), while the Al-Haouz' region province is predominantly rural, with an urbanization rate not exceeding 14.7% [12].

In this study, the aim was to describe the sedentary behavior, the physical activity level (PAL) and the anthropometric parameters and, to analyze the association of the PAL with the corpulence status, in a group of high school students aged 15 to 19 years old in the city of Marrakech and the province of Al-Haouz of the Marrakech-Safi region.

Methods

Survey variables

A cross-sectional survey was conducted in 2015 among high school students in Marrakech city (urban area) and in the province of Al-Haouz (rural area). The questionnaire-based survey and the interviews with individual students were designed to collect detailed information on the socio-economic and cultural conditions of private households, the overall lifestyle, the respondent's range of sedentary activities and their usual physical activities such as those involving the need to meet the requirements of daily life, the social and school life and other sporting and/or leisure activities taking into account a multitude of factors such as the type and the frequency of the activities and their intensity as well as duration. We have gathered the basic anthropometric measurements relative to weight, height and the body FM percentages of each respondent.

Sampling and Setting

No specific exclusion criteria were applied and all students enrolled in educational institutions in Marrakech city and Al-Haouz province had equal opportunity to be included in this research study. The selection was made in two stages:

1st stage: selection of schools: the high schools included in this study were selected using a random draw of the ones listed in the directory belonging to the Regional Academy for Education and Training in Marrakech-Safi region [13]. The high schools were numbered according to their sequence in the directory.

2nd stage: selection of individuals: in each school selected in the 1st stage, we randomly chose numbers (each number corresponds to a student) from the student lists provided by the school administration.

We note that the selection of both schools and students was made randomly via «RANDBETWEEN (min, max) » in Excel.

The survey was conducted in five territorial communities in Al-Haouz province and in four boroughs of Marrakech city. Table 1 shows the breakdown of numbers and percentages (%) of respondents by each venue surveyed. The sample consists of 1173 subjects including 48.3% girls. 56.9% of them come from rural areas and 42.3% from urban areas.

Area	Localities surveyed	Male		Female		Overall		Overall /Area
		N	(%)	N	(%)	N	(%)	
Rural	AIT OURIR	72	(54.1)	61	(45.9)	133	(11.3)	N = 667 56.8 %
	AMIZMIZ	92	(49.2)	95	(50.8)	187	(15.9)	
	ASNI	61	(62.2)	37	(37.8)	98	(8.4)	
	TAHANAOUD	52	(46.0)	61	(54.0)	113	(9.6)	
	TOUAMA	78	(57.4)	58	(42.6)	136	(11.6)	
Urban	MENARA	114	(50.2)	113	(49.8)	227	(19.4)	N= 506 43.2 %
	GUELIZ	59	(69.4)	26	(30.6)	85	(7.2)	
	MEDINA	38	(34.5)	72	(65.5)	110	(9.4)	
	SYBA	41	(48.8)	43	(51.2)	84	(7.2)	
Overall		607	(51.7)	566	(48.3)	1173	(100.0)	100.0 %

Table 1: The distribution of students in terms of location of survey (administrative unit), gender and area of residence.

Table 2 shows the breakdown of respondents by age range (from 15 to 19 with an average of 17.54 ± 1.59 years old), gender and area of residence.

	Rural				Urban				Overall	
Age (years)	Boys		Girls		Boys		Girls			
	N	%	N	%	N	%	N	%	N	%
15+	45	12.7	44	14.1	72	28.6	63	24.8	224	19.1
16+	52	14.6	83	26.6	47	18.7	35	13.8	217	18.5
17+	121	34.1	105	33.6	33	13.1	72	28.3	331	28.2
18+	51	14.4	32	10.3	46	18.2	46	18.1	175	14.9
19+	86	12.1	48	7.7	54	10.7	38	7.5	226	9.65
Overall	355	100.0	312	100.0	252	100.0	254	100.0	1173	100.0

Table 2: The distribution of students by age group, gender and area of residence.

Table 3 describes the average socio-economic profile of the two surveyed groups. It appears that in 92% of the cases, the Father is the head of the household and in 4% the Mother. We have looked at the occupation of the head of the household towards a classification of socio-professional categories (SPC) following the classification proposed by Orban-Segebarth and colleagues [14] (see legend of table 3). The SPC3 is found to be a common feature of rural areas, it represents roughly 72 % while 52.4 % in urban ones. However, The SPC1 (supposed to the wealthiest class) is less common in rural areas compared to urban ones. More than 50 % of households are within low income brackets and even below the guaranteed inter-professional minimum wage (SMIG). 25 % of them reach an equivalent of 5000 Moroccan Dirhams (a double of SMIG) and this figure masks the disparities existing within the two areas. The socio-economic profile also shows the gaps in educational attainment among the heads of households as well as the differences in the family modes of transport across the two areas.

		Area of residence				Overall	
	<i>Rural</i>	<i>Urban</i>					
<i>Variables</i>	<i>Modalities</i>	<i>N</i>	<i>(%)</i>	<i>N</i>	<i>(%)</i>	<i>N</i>	<i>(%)</i>
<i>Head of household</i>	<i>Father</i>	613	(94.3)	396	(89.0)	1009	(92.1)
	<i>Mother</i>	18	(2.8)	26	(5.8)	44	(4.0)
	<i>Other</i>	19	(2.9)	23	(5.2)	42	(3.8)
<i>Education level of the head of household</i>	<i>None</i>	316	(50.0)	119	(27.6)	435	(40.9)
	<i>Fundamental</i>	132	(20.9)	52	(12.1)	184	(17.3)
	<i>Secondary</i>	110	(17.4)	113	(26.2)	223	(21.0)
	<i>Superior</i>	74	(11.7)	147	(34.1)	221	(20.8)
<i>socio-professional categories of the household head</i>	<i>SPC1</i>	30	(5.0)	39	(9.8)	69	(6.9)
	<i>SPC2</i>	127	(21.1)	123	(31.0)	250	(25.0)
	<i>SPC3</i>	432	(71.8)	208	(52.4)	640	(64.1)
	<i>SPC4</i>	13	(2.2)	27	(6.8)	40	(4.0)
<i>Monthly income level (Moroccan Dirham)</i>	<i>Less than 2000</i>	144	(23.4)	70	(5.61)	214	(20.1)
	<i>2000 to 3000</i>	193	(31.3)	117	(26.1)	310	(29.1)
	<i>3000 to 5000</i>	165	(26.8)	102	(22.7)	267	(25.1)
	<i>More than 5000</i>	114	(18.5)	160	(35.6)	274	(25.7)
<i>Family transportation facilities</i>	<i>Car</i>	183	(27.4)	232	(45.8)	415	(35.4)
	<i>Motorbike</i>	172	(25.8)	119	(23.5)	291	(24.8)
	<i>Bike</i>	71	(10.6)	24	(4.7)	95	(8.1)
	<i>None</i>	241	(36.1)	131	(25.9)	372	(31.7)
SPC1: Gathering the big traders and liberal professions; SPC2: Gathering the workers and professional executives; SPC3: Gathering: Artisans, employees, workers, farmers, drivers , trader assistants; SPC4: People without any specific profession.							

Table 3: Socioeconomic profile average of households.

Physical Activity and Energy Expenditure

Physical activity (PA) is defined as the number of the situations (during a given period of time, per day or per week) requiring the involvement of the skeletal muscle system and, thus, increasing energy expenditure as compared to periods of rest [15].

In our methodology, the PA was assessed by describing the weekly physical activities (duration, frequency and intensity) in four important contexts of life, namely Domestic, Transportation, School, Sport and leisure. The PA intensity is measured by evaluating the amount of energy expended compared to the Metabolic Equivalent of the Task (MET) in periods of rest. The values calculated in Table 4 were derived according to the type of PA and practice context, in accordance with the latest update of the compendium of physical activities [16]. The values considered within the school are analogous to the ones in sport and leisure context because school sports, which constitute the main school physical activity, are generally practiced as sporting activities. We have also taken into account the MET corresponding to the sporting activity practiced during the last accomplished teaching cycle.

<i>Context or domain of physical activity</i>	<i>Physical activity</i>	<i>MET</i>	<i>2011 Compendium Code</i>
<ul style="list-style-type: none"> Sports and leisure activities School 	Walking	4.8	17302
	Bicycling, general	7.5	01015
	Bicycling, stationary	7.0	02010
	Football	8	15210
	Basketball	8	15040
	Volleyball	4	15710
	Handball	8	15330
	Jogging, general	7.0	12020
	Aerobic	7.3	03015
	Dance	5.0	03010
	Gymnastic	3.8	15300
	Track and field (shot, discus)	4.0	15732
	Track and field (Javelin)	6.0	15733
	Track and field (Jumps)	6.0	15733
	Track and field (steeplechase, hurdles)	10.0	15734
	Swimming, training or competition	10.8	18260
	Swimming laps, freestyle, front crawl, slow, light or moderate effort	5.8	18240
	Running, cross country	9.0	12140
	Martial arts	10.3	15430
<ul style="list-style-type: none"> Domestic physical activities 	Light	2.8	05025
	Moderate	3.5	05026
	Vigorous	4.3	05027
<ul style="list-style-type: none"> Transportation mode 	Walking	4.0	17270
	Bike	6.8	01011
	Motorized (e.g., Car, Bus)	0.0	

Table 4: The values of the physical activity intensity considered in the calculations (expressed in MET).

Physical activity linked to energy expenditure (PAEE) during a typical week is calculated by multiplying the duration (hour), the frequency (days per week) and the intensity (MET) according to the equation commonly used in the literature [16-19]. On the basis of this PAEE accumulated for a period of one typical week, with reference to the last three months, we distinguished three different levels of physical activity: « Sedentary», « Moderate » and « vigorous».

According to international recommendations [20, 21], the daily dose recommended for young people is the accumulation of 60 minutes (1 hour) of moderate PA per day, which is 7 hours per week. The energy cost relative to such a moderate activity is set between 3 and 6 MET [10, 22-24]. In our calculations, we applied 3 MET as a threshold to calculate the lowest value of the PAEE equivalent to the recommended dose, as follows: $PAEE = 7 \text{ (hours)} \times 3MET = 21 \text{ MET}$.

In this study, we classify as « sedentary » PAL, the subject that does not accumulate 10.5 MET (equivalent to half the recommended dose) and as « Moderate » PAL, the subject accumulating at least 10.5 MET but not reaching 21 MET (the recommended dose) while the subject who reaches or exceeds 21 MET is classified as « Vigorous » PAL.

Measurements and anthropometric indicators

The anthropometric measurements were taken as follows: weight was measured by means of a weighing scale, type SECA with an average accuracy of 0.1 kg; height was measured by means of a demountable anthropometric measuring rod with an average accuracy of 0.1 cm, and the percentage of fat mass (FM) were assessed by means of impedance-meter (Tanita BC 545N).

Statistical Processing and Data Analysis

The acquisition and statistical processing of data were carried out by SPSS-win software, version 20 and as for qualitative data, the frequency and percentage variations were made via the statistical test, Khi-2. The means of quantitative parameters were compared by means of the average-to-average parametric test (Student t-test) or by means of ANOVA Test if there are more than two means to compare. To measure the significance of variations, a post-hoc comparison of means testing was done (LSD or least significant different test). Except as otherwise stated, data is expressed as mean \pm standard deviation (SD) or percentage, according to data type. The threshold for statistical significance for all tests was set at $p=0.05$.

Results

Anthropometric characteristics by gender and area of residence

The mean values of the basic anthropometric measurements are indicated in table 5 and they reveal that the average heights and weights among boys are higher than among girls. The corresponding statistical tests resulted respectively in the following: ($t=21.32$; $p<0.001$) and ($t=9.69$; $p<0.001$). The mean values also vary according to area of residence and, the mean heights among boys are greater in rural areas compared to urban ones whereas for girls, the mean heights in rural areas are lower than in urban ones. An extreme sexual dimorphism is exhibited in rural areas as the difference in height goes up to roughly 11 cm in favor of boys, but does not exceed 8 cm in urban areas. The weight is higher among urban students compared to their rural counterparts, for both boys and girls (the t-test in indicated in table 5).

The Body Mass Index (BMI), which is calculated by dividing weight in kg by height squared, considerably varies by gender, with values significantly much higher ($t=-3.11$; $p<0.01$) among girls than among boys (table 5). It also varies by place of residence with significantly more important average in rural than in urban areas and among both sexes. About the body FM, the mean value among girls (22.57%) was significantly ($t=-24$; $p<0.001$) higher than among boys (14.27%). According to the place of residence, the FM mean values among urban students are higher than among rural ones with a difference going up to 1.55% among boys and to 3.51 % among girls.

		Boys			Girls		
		Rural	Urban	Overall	Rural	Urban	Overall
Height (cm)	Average	171.19	169.31	170.42	159.88	161.34	160.53
	SD	7.44	9.72	8.48	6.36	7.34	6.84
	N	352	244	596	310	253	563
	t-Test	t = 2.55 ; *			t = -2.49 ; *		
Weight (kg)	Average	58.88	61.84	60.09	53.01	57.11	54.82
	SD	9.54	10.70	10.12	8.02	9.49	8.93
	N	352	244	596	308	244	563
	t-Test	t = -3.46 ; **			t = -5.39 ; ***		

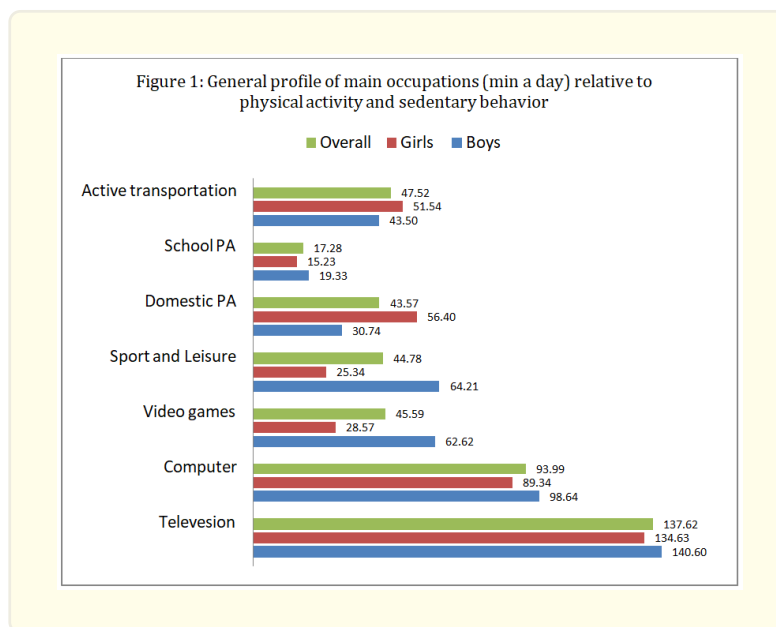
BMI (kg/ m ²)	Average	20.06	21.58	20.67	20.73	21.89	21.24
	SD	2.76	3.45	3.14	2.72	3.10	2.94
	N	352	244	594	308	244	552
	t-Test	t = -5.73; ***			t = -4.62; ***		
Fat Mass (%)	Average	13.64	15.19	14.27	21.02	24.53	22.57
	SD	5.72	5.19	5.56	6.64	4.70	6.11
	N	308	244	595	308	244	552
	t-Test	t = -3.43; **			t = -7.26; ***		

* p<0.05; **p<0.01; ***p<0.001; BMI: Body mass index.

Table 5: Anthropometric characteristics by gender and area of residence.

Description of data relative to PA and sedentary lifestyle activities

Figure 1 shows that, generally, television is the major preoccupation of high school students (roughly 140 min/day), followed computer (nearly 100 min/day). Other activities such as sports and leisure, physical activities related to transport and domestic chores, and video games come next with less than one hour each (about 45 min/day) and PA within schools comes last with in average less than 18 min/day. However, this description of major concerns shows some significant gender differences. It is noted that boys spend more time in front of screens than girls, namely playing video games (60 min/day against less than 30 min/day). The boys' PA exceeds in sports and leisure (about 65 min against 25 min per day) whereas girls are the winners in domestic-related activities (nearly one hour against half an hour for boys).



Physical Activity Level

Table 6 describes the PAL among respondents and, in general, nearly 42% of the study' schoolers are ranked with « Moderate» PAL, a quarter of them (25%) reaches the « Vigorous » PAL, while about 33% are less active and belong to the « Sedentary » PAL. The sexual dimorphism is clear-cut as about 45% of girls belong to the « Sedentary » PAL against 21% only of boys. In the opposite, nearly 40 % of boys and only 10% of girls reach the « Vigorous » PAL. According to place of residence, the PAL is largely lower among urban boys compared to their counterparts in rural areas with 29% sedentary active (Sedentary PAL) against 15% respectively. Among girls, however, no significant difference between the two areas (urban and rural) is noted.

The association between the PAL and corpulence (BMI and FM)

The results shown in table 7 indicate that (after adjusting for age and gender) BMI and the body FM are significantly associated with the PAL. The higher the PAL, the lower are the averages of BMI and the FM. Among boys, the difference between the group belonging to « Sedentary » PAL and that belonging to « Vigorous » PAL, the averages reach 1.24 kg/m² for BMI and 1.62% for the FM. Among girls, the difference between the averages reach, respectively, 1.33 kg/m² and 2.48%.

Discussion

The present reported data shows that a quarter of the students' sample of Marrakech-Safi region high schools responds to the recommended dose of PA. Indeed, « Vigorous» PAL was prevalent in a proportion of only 25% of the surveyed youngster, indicating a low PA in this population sample which is well below the international recommendations level [21]. Unlike urban students, rural students are more active probably because of their engagement in more physical activities in domestic areas such as working in the fields or in household chores and use of active transportation modes (e.g. biking or walking) to attend schools. The rural geography itself can contribute to an increase in PAEE because the location of schools in rural areas, in majority most often situated far from students' homes. It is noticed that generally boys are more active than girls and this is consistent with the HBSC (Health Behavior in School-aged Children) study data published by the WHO reporting that girls are systematically less active than boys [25-28]. In this study, boys are more to practice sporting and leisure activities whereas girls are exert more domestic areas activities. The last results are similar to those recorded in a study conducted in Europe [29]. Similarly, results published by OEDC also agree that girls tend to be less active than boys [30]. The present study reveals a significant association of the corpulence status with the PAL. The higher the PAL, the lower are the means BMI and FM percentage which is consistent with results from international researches on youth, showing a significant effect of PA on corpulence [31] and a lower adipose tissues in individuals who engage in a relatively important PA than those who do not practice physical exercise [10, 31]. Other research data have also shown a clear link between intensive PA and weight stability [32-34]. Wilmore et al. found that physical endurance training for 5 months reduces BMI and total body and subcutaneous abdominal fat [35] and Mertens et al. reported that even a moderate PA level, over several months reduces the overall weight and the body FM [36]. The effect of exercise on weight control occurs when the energy expended during an activity is greater than the energy expended at rest (consumption of muscle glycogen stores in exercise) and during the recovery of these stores at the end of the exerted activity. Other studies have shown that weight loss is even more noticeable when the level of energy expended is even higher [37-39]. In general, PA has positive effects, a psychological stimulant, improving mood, feelings of comfort and well-being increasing thus the self-esteem of individuals [40, 41], a such effects helps to limit weight gain over the years [42, 43].

Limitations

This survey has however, some limitations that should be mentioned:

The cross-sectional design of the survey is not conducive to establishing causal links between the various parameters studied.

- Data on nutrition that are lacking in this study, could also have provided additional information and explanations for the discussion of the study results.

- Self-reporting, using the questionnaire as a tool for collecting data on the individuals themselves, is likely to overestimate the duration and frequencies claimed for PA, and even to generate omission-related problems (with reference to memory).

Conclusion

Overall, the present study results showed that the surveyed students are not sufficiently physically active. The PAL is significantly associated with anthropometric indicators of corpulence (BMI and FM). In view of the growing obesity-related health issues, along with the ever-increasing sedentary lifestyles, PA should be part of everyone's daily routine, in schools as well as in their daily journeys, on the one hand and, in the other hand, a basis for each regularly practiced leisure activity. Particular attention must be paid to sport institutions (clubs, associations and youth centers), in view of upgrading sport facilities and mentoring young people, in an effort to enhance the practice of recreational and sports activities outside the conventional educational institutions. It is also important to review the physical education course schedules at schools and thereby increase the students' effective participation and commitment. Considering that a sedentary lifestyle along with behaviors and habits acquired in adolescence are more likely to be maintained and persist for the rest of one's life, specific and adapted strategies and programs need to be implemented to promote sport and PA among students and young people in general. Such strategies need to be adapted according the differences of gender on the one hand, and of rural/urban area of residence on the other.

What is already know on this topic

Physical activity brings a certain benefit for health; this is the general observation on this subject, which is widely studied internationally. However, many studies are limited, in their objectives, to sports or leisure activities and some others add the physical activity of transportation.

Several studies agree that the Physical activity is associated to body composition in different regions of the world.

What this study adds

The study provides new data on a topic that has been less studied in the region of Marrakech (Morocco).

To increase physical activity level, everyone needs to be active routinely at home, at work or at school, on transportation and during leisure time.

Competing interests

The authors declare no competing interest.

Authors' contributions

All authors have contributed to the manuscript.

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Perspective

Our findings suggest that BMI and FM averages among physically active individuals are lower compared to those observed among less active individuals. This association cannot, however, be expressed in a unidirectional way only, which states that PA reduces the BMI and FM, and it is possible that overweight subjects simply do less physical exercise. Hence, more studies are required to dwell further on this connection and establish the level and degree of such relationship, namely tracing the dose-response relationship during a regular exercising program and, to assess the degree of acceptability and willingness shown by the overweight subjects towards physical exercise.

Ethical Considerations

The survey was conducted in the form of an interview with each student individually and the principle of volunteering before participating in the survey as well as the confidentiality and anonymity of the questionnaire were respected. Authorization to carry out the survey within educational institutions was obtained from the Regional Academy of Education and Training of the Marrakech-Safi region.

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