Correlational relationship between Physical Activity and Sedentary Behavior among Moroccan High School Students

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Abstract.
Objective: Non-communicable diseases are the leading causes of death worldwide. These risk factors are closely related to physical activity and sedentary behaviors. Therefore, this study aims to determine the prevalence of physical inactivity and sedentary behaviors and their association among Moroccan high school students aged 15 to 20 years.
Materials: A sample of 180 students (80 boys and 100 girls), enrolled in high schools in 2019 academic year in the Province of Sidi Kacem, were randomly recruited. A validated self-reported questionnaire was used to assess levels of physical activity and sedentary behaviors among participants.
Results: According to the results obtained, 74.2% of boys and 46.9% of girls were physically active. 45.5% of girls and 20% of boys spent more than 2 hours watching television, and 57.3% of girls and 48.5% of boys used sedentary means for more than two hours per day. There were statistically significant negative correlation between levels of physical activity and sedentary behaviors.
Conclusion: A large part of the population has a sedentary lifestyle. This lack of physical activity and high prevalence of sedentary behaviors could have a direct impact on health. Additional physical activity and sports sessions are necessary and strongly recommended.
Keywords: adolescents, Morocco, physical activity, sedentary lifestyle, sport.

I. Introduction:

Non-communicable diseases (NCDs) are the leading causes of all deaths, accounting for 80% of all deaths in Morocco [1]. The most important risks of NCDs include high blood pressure, high blood cholesterol levels, inadequate fruit and vegetable intake, and overweight or obesity [2]. These risk factors are closely linked to the level of physical activity and sedentary behavior.

Physical inactivity is a significant risk factor for NCDs such as stroke, diabetes, and cancer. Currently, physical activity is declining in Morocco, particularly among young people [3]. In Morocco, 48.6% of girls and 23.5% of boys in school are physically inactive [3] Moroccan boys are more physically active than [3,4].

Participation in beneficial physical activity is a key determinant of energy expenditure in youth and leads to better cardiovascular and metabolic health as well as good bone status [5, 6]. Thus, physical activity plays an important role in preventing overweight and obesity during childhood and adolescence and reduces the risk of obesity in adulthood [7]. Indeed, recent research has shown that sedentary behavior (watching television (TV)) and physical activity seem to be distinct entities and are independently associated with obesity and metabolic risk [8].

Physical inactivity, sedentary behavior, and unhealthy diets are considered the leading causes of non-communicable diseases, contributing significantly to the global burden of morbidity, mortality, and disability [9].

Few studies have examined the correlational relationship between levels of physical activity and sedentary behavior. Therefore, the objective of this study was to assess the prevalence of physical activity, sedentary behavior, and their correlational associations among Moroccan high school students in the province of Sidi Kacem.

II. Methodology

II.1. Population

The total sample consisted of 180 male and female adolescents enrolled in high schools in the province of Sidi Kacem, Morocco. The classes were selected randomly. Specifically, six classes were chosen randomly, and then one class was randomly selected from each of the three school years (common core, 1st year of baccalaureate, and 2nd year of baccalaureate). All classes were mixed (boys and girls) and all participants were apparently healthy without any physical disability. Data were collected, avoiding any data collection during hot, humid, or very cold months, as these environmental conditions may have a negative effect on physical activity levels [3]. There were an average of 30 students per class, for a total of six selected classes.

II.2. Evaluation of physical activity and inactivity

A self-administered questionnaire was utilized to evaluate the degree of physical activity. This method facilitated the compilation of extensive data on the frequency, duration, and intensity of several physical activities typically performed during a week. The physical activity questionnaire was a modified questionnaire based on an original questionnaire that had previously demonstrated high reliability (ICC = 0.85; 95% CL = 0.70-0.93) and acceptable validity ($r = 0.30$; $p < 0.05$) compared to pedometer measures using a practical sample of young boys aged 15 to 25 years [10, 11]. In another validity study involving both girls and boys aged 14 to 19 years, the current physical activity questionnaire was also validated against electronic pedometer measures and was found to have an acceptable validity coefficient ($r = 0.37$, $p < 0.001$) [12].

The questionnaires were filled out by the participants in class. Data collection was avoided during hot, humid, or very cold months, and during national and regional exam days, as these conditions may have a negative effect on the level of physical activity [3]. Moderate-intensity physical activities were assigned MET values based on the tables of physical

activity compendia [13, 14]. Moderate-intensity recreational sports were assigned an average MET value of 4 METs. Slow walking, normal walking, and fast walking were assigned MET values of 2.8, 3.5, and 4.5 METs, respectively, based on modified MET values from the youth physical activity compendium [14]. Intense physical activity included activities such as stair climbing, jogging, running, cycling, self-defense, weightlifting, and intense sports such as football, basketball, handball, individual tennis, etc. Intense sports were assigned an average MET value of 8 METs.

The study participants were classified into two groups (active or inactive) based on total physical activity scores of 1680 MET-minutes per week (60 minutes per day × 7 days per week × 4 METs), which corresponded to 1 hour of moderate-intensity physical activity each day [12]. At least 1 hour of moderate-intensity physical activity per day is the minimum recommended duration of physical activity for children and youth [6].

II.3. Sedentary behaviors

The questions on sedentary behaviors followed questions on physical activities and were designed to assess the typical amount of time spent each day watching television, using the computer and the internet, as well as the number of hours of sleep per day (night and day) [3]. Participants were asked to indicate their typical time (hours) spent on these activities without making a distinction between weekdays and weekends. The maximum time spent in sedentary behaviors (watching television, using the computer) was used to classify the study population into two categories (≤ 2 and > 2 hours/day). We used the recommendations of the American Academy of Pediatrics for a maximum of 2 hours per day (AAP, 2001).

III. Results

III.1. Physical activity levels

Table 1 presents the general characteristics and physical activity profiles of the participants. The results indicate that there was a statistically significant difference in the average age of adolescents based on their gender (p=0.000). Most boys participated in sports activities with their friends on the streets or at sports clubs, while a significant proportion of girls engaged in sports at school or at home with their classmates or alone. Moreover, a substantial number of adolescents (both boys and girls) preferred to engage in physical activities in the morning, while others did not have a specific time preference. Statistically significant gender differences were observed for the accompaniment, location, and duration of physical activity practice (p=0.000).

Table 1. Descriptive Characteristics and Physical Activity Profiles.

Variable		**Boys**	**Girls**	***p*-value**
Gender (%)		44.4	55.5	-
Age		18.61±1.71	17.08±1.59	0.000
Place	At home	12.5	38.1	
	In high school	14.3	42.2	0.000
	In the street	42.4	10.3	

	In the sports club	30.2	8.4	
	In the health or leisure center or other places	0.6	1	
Accompaniement	Person	10.3	20.3	
	With related friends	59.4	21.4	
	With classmates	23.7	44.8	0.000
	The parents	1.8	9	
	With others	4.8	4.5	
Period	Morning	32.5	40.6	
	Afternoon	6	9.5	
	Evening	18.6	14.6	0.000
	after sunset	10	4.5	
	After dinner	3.8	2.5	
	No specific time	23.1	28.3	

Table 2. Measures of physical activity and energy expenditure

	Boys	**Girls**	***P*-value**
Physical activity measures Energy expenditure (MET-min /week)			
Moderate physical activity	1058.354±1016.73	1477.63±1581.11	0.005
Vigorous physical activity	3211.21±2423.34	1001.79 ±1453.81	0.000
Total MET-min / week	4288.81 ±3056.87	2459.97±2462.34	0.000
(< 1680 MET-min / week) (%)	25.8	53.1	0.000

The results showed that there is a statistically significant difference ($p<0.05$) in the physical activity levels between boys and girls, with boys being more active than girls during a typical week. The total MET-min score per week was significantly higher in boys compared to girls ($P<0.000$). Girls, on the other hand, had significantly higher levels of moderate physical activity than boys ($P<0.005$). However, boys spent significantly more time engaging in intense physical activities ($P<0.000$). Compared to global recommendations for daily physical activity, several Moroccan adolescents did not meet the recommended one hour of moderate-intensity physical activity with a statistically significant difference based on sex ($P<0.00$). In fact, more than half of the girls (53.1%) and 25.8% of the boys did not reach the recommended level of moderate-intensity physical activity (≥ 1680 MET-min/week), while 74.2% of boys and less than half of the girls (46.9%) met the recommendations for daily physical activity.

III.2. sedentary behaviors

Table 3. Measures of physical activity and energy expenditure

	Boys	**Girls**	p-value
Sedentary activity measures			
Watching TV > 2 hrs/d (%)	20	45.5	0.005
Use of computer and smartphone > 2 h / d (%)	48.5	57.3	0.005
Sleep < 7 h / d (%)	25	30.7	0.005

Table 3 presents the results obtained on the duration of sedentary behaviors among the adolescents studied. The findings reveal that girls are significantly more sedentary than boys (p=0.005). Specifically, a higher percentage of girls (45.5%) spent more than 2 hours a day watching television, while a quarter of boys (20%) did the same. Additionally, during this same period, more than half of the girls (57.3%) and almost half of the boys (48.5%) used a computer or smartphone (p=0.005).

III.3. Correlational relationships between physical activity levels and sedentary behaviors

Table 4. Correlational relationships between physical activity and sedentary behaviors.

	1	2	3	4	5	6	7	8	9
Time in front of the television	1	,286**	,791**	0,035	-,168**	-,093*	0,048	-,161**	-,100**
		0	0	0,371	0	0,017	0,217	0	0,01
Time in front of the computer	,286**	1	,813**	0,028	-0,015	0,005	0,025	-0,042	-0,021
	0		0	0,466	0,698	0,897	0,514	0,276	0,598
Total screen time	,791**	,813**	1	0,039	-,112**	-0,053	0,045	-,125**	-0,074
	0	0		0,313	0,004	0,172	0,243	0,001	0,056
Duration of moderate physical activity	0,035	0,028	0,039	1	,406**	,798**	,846**	,315**	,639**
	0,371	0,466	0,313		0	0	0	0	0
Duration of intense physical activity	-,168**	-0,015	-,112**	,406**	1	,875**	,317**	,894**	,833**
	0	0,698	0,004	0		0	0	0	0
Total physical activity time	-,093*	0,005	-0,053	,798**	,875**	1	,658**	,757**	,888**
	0,017	0,897	0,172	0	0		0	0	0
Energy expenditure (MET-min /week)	0,048	0,025	0,045	,846**	,317**	,658**	1	,269**	,676**
	0,217	0,514	0,243	0	0	0		0	0
Energy expenditure (MET-min /week)	-,161**	-0,042	-,125**	,315**	,894**	,757**	,269**	1	,892**
	0	0,276	0,001	0	0	0	0		0
Energy expenditure (MET-min /week)	-,100**	-0,021	-0,074	,639**	,833**	,888**	,676**	,892**	1
	0,01	0,598	0,056	0	0	0	0	0	

We conducted correlational analyses between levels of physical activity (moderate physical activity, vigorous physical activity, and total physical activity), sedentary behaviors

(duration of television viewing, computer use, and total screen time), and energy expenditure in physical activity. The findings reveal strong negative associations between television viewing time and physical activity duration (r = -,0168**; p = 0.00). Generally, there are significant negative associations between television viewing time and total physical activity duration (r = -,093*; p = 0.001). There is also a significant positive negative relationship between television viewing time and energy expenditure in intense physical activity (r = -,161**, p = 0.00).

There is a significant positive negative relationship between television viewing time and total energy expenditure (r = -,100**, p = 0.01). Regarding computer use, it has a negative relationship with the duration of intense physical activity and energy expenditure in intense physical activity. Generally, there is a negative relationship between sedentary behaviors and total physical activity duration, especially in intense physical activity (r = -0.172**; p = 0.004), and energy expenditure in intense physical activity (r = -0.125**; p = 0.001).

IV. Discussion

Despite the major lifestyle changes in Moroccan society over the past decade, including population growth, technological revolution, the development of social networks, and intense competition among telecommunications companies in Morocco, limited research has been conducted on the physical activity and sedentary behavior of Moroccan adolescents [3]. This research aims to determine the correlation between physical activity levels and sedentary behavior among Moroccan high school students. Overall, the results of this study show a significant negative correlation between physical activity levels and sedentary behavior among the studied population.

- Physical activity

A large portion of boys preferred to engage in sports in the street and at sports clubs with related friends. These findings are consistent with those reported by EL Oirdi H. [3,4]. However, a significant proportion of girls engaged in physical and sports activities at school or at home, with classmates or alone. These results are similar to those found in the province of Sidi Kacem [3,4] Furthermore, a significant proportion of adolescents (boys and girls) preferred to engage in physical activities during the morning, while others did not have a preferred time. Statistically significant differences were reported based on gender for accompanying people, location, and duration of physical activity practice, all of which were similar to the study by El Oirdi [3,4].

A significant proportion (53.1%) of girls and more than a quarter (25.8%) of boys did not engage in at least one hour of moderate-intensity physical activity per day. These findings are consistent with those found in the study of Sidi Kacem, where 48.6% of girls and 23.5% of boys did not engage in at least one hour of physical activity per day [3,4]. However, they are higher than those found in adolescents from Kenitra, where 9% of boys and 32% of girls did not meet physical activity recommendations [16], and in another study conducted in Taza, where 50% of boys and 66.6% of girls did not meet these recommendations [17].

This significant difference may be due to the geographical differences between cities, socioeconomic and traditional factors [3,4]. The main factors contributing to adolescent inactivity in Morocco include short distances for commuting to schools, short durations reserved for physical education and sports sessions in schools and reduced recreational facilities [3]. These factors also lead families to discourage their daughters from engaging

in physical activity [3]. Elsewhere, boys were more likely than girls to engage in physical activities [18].

Physical activity levels among adolescents have been widely reported in different countries, but most of them do not meet the recommended levels [19]. It should be noted that physical activity levels among Arab girls, in all regions, were lower than those of boys [20].

- **Sedentary behaviors:**

The American Academy of Pediatrics (AAP) recommendations for adolescents do not exceed 2 hours per day [15]. Children who watch television for an hour or less per day have a lower prevalence of obesity [21].

Unfortunately, our results have shown a high prevalence of sedentary behavior among the studied high school students, with 20% of boys and almost half of girls (45.5%) spending more than two hours per day watching television and 48.5% of boys and 57.3% of girls using the internet and smartphone during the same period.

These results are similar to those found in the province of Sidi Kacem [3]. this province, 26% of boys and 43.4% of girls spend more than 2 hours per day watching television and 36.1% of boys and 46.4% of girls using the computer, internet, and smartphone for more than two hours per day [3].

Factors contributing to the increase in sedentary activities in Morocco include the increase in telecommunications means, such as computers, tablets, and smartphones, and the large number of television channels [3]. Over the years, the use of telecommunications means has increased compared to television viewing due to the prevalence of channels on YouTube addressed to adolescents, social media (Facebook, Twitter, Instagram, WhatsApp, video games), and the great ease of access to the internet due to the high competition between telecommunications companies [3].

Sedentary behaviors in young people can be reduced by increasing opportunities for physical activity in schools and the community [3].

- **Correlational relationship between physical activity levels and sedentary behaviors**

The correlational relationship between levels of physical activity and sedentary behaviors is an important research topic in the field of public health. The results of the present study reveal a strongly statistically significant negative correlation between total sedentary duration, total physical activity duration, and total energy expenditure in physical activity. This means that people who have higher levels of physical activity tend to have less frequent sedentary behaviors.

This correlation has important implications for health. Physical activity is beneficial for overall health, reducing the risk of the same diseases and contributing to a better quality of life. However, sedentary behaviors, such as watching television or using the computer, internet, and smartphone for long periods, are associated with an increased risk of non-communicable diseases such as obesity, type 2 diabetes, and cardiovascular diseases. Factors that may influence both physical activity and sedentary behaviors contribute to the high prevalence of chronic disease risk factors, including age, sex, socioeconomic status, and education level.

V. conclusion

Levels of physical activity and sedentary behaviors are significantly related. It is important to raise public awareness about these issues and encourage individuals to adopt a more active and less sedentary lifestyle. Health promotion interventions such as exercise programs and policies that promote physical activity can help to reduce the prevalence of sedentary behaviors and improve the overall health of the population.

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