Effect of exercise intensity on sleep quality among school adolescents in the Provincial Directorate of Meknes-Morocco: Sports and Health

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Abstract. Physical activity levels and sleep quality are two crucial aspects that can significantly influence overall health. Research has established a significant relationship between these two aspects. A group of 300 high school students (120 boys and 180 girls) enrolled in schools in the province of Meknes during 2021 was randomly selected. A validated self-report questionnaire was used to assess the intensity of physical activity and sleep duration among participants. This study revealed a positive correlation between the intensity of physical activity and sleep duration. An intense physical activity level was significantly positively associated with sleep duration. This study revealed a positive correlation between physical activity levels and sleep duration. These findings suggest that increasing physical activity may improve sleep quality. However, it is important to consider other factors to enhance overall sleep quality. ***Keywords**:* sporting activity, sleep, adolescents, Morocco.

1 Introduction

Sleep deprivation is a widespread health issue affecting millions of people worldwide. The consequences of this deprivation can be severe, ranging from daytime drowsiness and decreased cognitive performance to more serious health problems such as obesity, diabetes, and cardiovascular diseases. Despite being crucial for both physical and mental well-being, sleep is often underestimated in our modern society, especially in a world where technology and distractions are ubiquitous. This scientific article will examine the causes and effects of sleep deprivation, as well as potential solutions to prevent and treat this common health issue. Additionally, currently, physical activity practices are declining in Morocco [1-4]. In Morocco, 48.6% of girls and 23.5% of boys aged 14 to 20 years are physically inactive [1]. Sleep deprivation can have adverse effects on health, including increasing the risk of various conditions such as high blood pressure, type 2 diabetes, obesity, mood disorders, cognitive problems, and car, work, and other accidents [5]. Sleep plays a crucial role in maintaining good health, both for individuals and for society. It allows the body and brain to recover after a day of activity, whether professional, academic, or physical. Moreover, good night sleep is beneficial for productivity, creativity, and decision-making ability. In contrast, sleep deprivation can lead to physical and mental fatigue, decreased concentration and decision-making abilities, and risks to public safety due to daytime drowsiness, which can cause car and work accidents. According to a recent study conducted by El Oirdi [1], Only 55% of high school students in the province of Sidi Kacem, Morocco, respect the sleep duration recommended by the World Health Organization. In addition, few studies have examined the correlative relationship between physical activity intensity and sleep duration. Therefore, the objective of this study is to determine the levels of physical activity, sleep duration, and their correlations among Moroccan high school students in the Meknes province.

2 Materials and methods

2.2. Population studied

The total sample comprised 300 adolescents, both male and female, enrolled in high schools in the province of Meknes, Morocco. Initially, six classes were randomly selected, followed by the random selection of one class from each grade level (first year, first year of middle school, second year of middle school, third year of middle school). All classes were mixed, accommodating both boys and girls, and all participants appeared to be healthy, without any physical disabilities. The data were collected while avoiding months of extreme weather conditions (heat, humidity, or intense cold), which could have a negative impact on participants' physical activity levels [1]. On average, each class had approximately 36 enrolled adolescents, distributed between girls and boys.

2.3. Evaluation of sports activities

A self-report questionnaire was used to assess the participants' level of physical activity. It allowed for comprehensive information gathering on the frequency, duration, and intensity of various physical activities over a typical week [1-4]. The physical activity questionnaire is a modified version based on an original questionnaire that has 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 measurements using a convenient sample of young boys aged 15 to 25 years [6-7]. In another validity study involving both girls and boys aged 14 to 19, the current physical activity questionnaire was also validated against electronic pedometer measurements and was found to have an acceptable validity coefficient (r = 0.37, p <0.001) [8]. The questionnaires were completed by participants in the classroom under the supervision of their teachers and investigators. Data collection during hot, humid or very cold months, as well as during national and regional exam days, should be avoided because these conditions may have a negative effect on the level of physical activity [1-4].

Individuals with moderate-intensity physical activity were assigned MET values based on compendiums of physical activity tables [10-11]. Individuals who performed moderate-intensity recreational sports were assigned an average MET equivalent to 4 METs. Slow walking, normal-paced walking, and brisk 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 [11]. Intense physical activity includes activities such as stair climbing, jogging, running, cycling, self-defense, weightlifting, and intense sports such as football, basketball, handball and individual tennis. Intense sports were assigned an average MET value equivalent to 8 METs. The 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 corresponds to at least 1 hour of moderate-intensity physical activity per day [8]. One hour of at least moderate-intensity physical activity per day is the minimum recommended duration of physical activity for children and youth [9].

2.4. Sleep duration

Questions regarding sedentary behaviors were asked after questions about physical activity. They were designed to assess the daily time typically spent watching television, using the computer and the internet, as well as the number of hours of sleep per day (day and night) [8-10]. Participants were asked to give the time (in hours) they usually spend on these activities, without separating weekdays and weekends.

3 Results

General data on participants' physical activity profiles are presented in Table 1.

Table 1. Characteristics and profiles of sports activities.

Variable		Boys	Girls	P value
Gender (%)		44	60	-
Age		17.11±1.62	16.01±1.43	0.000
Place of Practice (%)	At home	11.6	36.2	0.000
	At school	15.2	44.1	
	In the streets	41.3	9.0	
	In sports club	31.4	9.5	
	In health or leisure center or other places	0.4	1,2	
Companionship (%)	Alone	11.3	21.4	0.000
	With related friends	58.4	20.3	
	With classmates	22.7	43.5	
	Parents	2.9	10	
	With others	4.7	4.8	
Practice Period	Morning	31.5	39.5	0.000
	Afternoon	11	10.6	
	Evening	17.6	13.5	
	After sunset	11	5.6	
	After dinner	4.8	3.3	
	No specific time	24.1	27.5	

The results indicate a statistically significant difference in the average age of adolescents based on gender (p=0.000). The majority of boys engaged in sports activities in streets (41.3%) and sports clubs (31.4%) with friends, while a significant proportion of girls practiced sports at school (44.1%) or at home (36.2%), with classmates or alone. Furthermore, a large proportion of adolescents (31.5% of boys and 39.5% of girls) preferred to exercise in the morning, while another portion had no specific schedule. Statistically significant differences were observed by sex for companionship, location, and duration of physical activity (p=0.000).

Table 2. Measurements of sports activities and energy expenditure

	Boys	Girls	P value
Physical Activity Measures Energy Expenditure (MET-min/week)			
Moderate Physical Activity	1021.453 ±1005.51	1487.63 ±1581.11	0.005
Vigorous Physical Activity	2942.31 ±2324.34	1011.61 ±1412.75	0.000
Total MET-min/week	3963.76 ±3055.87	2499.24 ±2452.34	0.000
(< 1680 MET-min/week) (%)	27.5	54.3	0.000

According to the data presented in Table 2, girls exhibit a significantly greater percentage of inactivity than boys (54.3% compared to only 27.5%) during a typical week (p <0.05). The total MET-min score per week was significantly greater for boys than for girls (p <0.000). Girls also demonstrated a significantly greater level of moderate physical activity than boys did (p <0.005). However, boys spent significantly more time performing vigorous physical activities (p <0.000). Regarding the global recommendations for daily physical activity (at least one hour of moderate physical activity), several adolescents in the province of Meknès did not adhere to them, with a statistically significant difference according to sex (p <0.00). In fact, fewer than half of the girls (45.9%) and 73.5% of the boys adhered to the physical activity recommendations (≥ 1680 MET-minutes/week). Figure 1 presents sleep duration in girls, boys and the entire study population. This visualization reveals several points: the majority of school-aged adolescents in the province of Meknes (54.82%) benefit

from a balanced sleep duration, between 7 and 8 hours per day (day and night), while more than 28% experience a short sleep duration, less than 6.9 hours per day. In addition, more than 16% of the adolescents had very long sleep durations. Overall, girls have a longer average sleep duration than boys. Table 3 presents the correlational analysis between durations of physical activity (moderate, intense, and total), energy expenditures, and sleep duration. The results revealed significantly positive associations between sleep duration and the duration of physical activity, particularly moderate physical activity (r=0.166**; p=0.00), as well as between sleep duration and time spent using the computer (r=0.15; p=0.00). Furthermore, a positive relationship was observed between sleep duration and total duration of physical activity (r=0.128**; p=0.001), as well as between sleep duration and energy expenditure, especially in moderate physical activity (r=0.141**; p=0.000). Overall, a positive correlation was established between sleep duration and total energy expended in physical activity (r=0.109**; p=0.005).

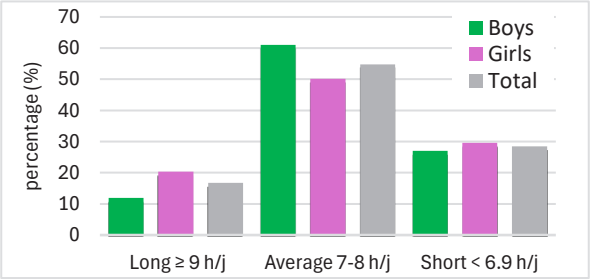

Fig. 1. Sleep duration among school adolescents in the provincial directorate of Meknes.

Table 3. Correlation between total sleep duration and intensity of sporting activity

	Total Sleep Duration
Moderate Physical Activity Duration	**0.166****
Vigorous Physical Activity Duration	**0.061**
Total Physical Activity Duration	**0.128****
Energy Expenditure in Moderate Physical Activity	**0.141****
Energy Expenditure in Vigorous Physical Activity (METs)	**0.057**
Total Energy Expenditure in Physical Activity	**0.109****

4 Discussion

Despite the major transformations in the way of life of Moroccan society over the last decade, including demographic growth, the technological revolution, the development of social networks and intense competition between telecommunications companies in Morocco, research on Physical activity and sedentary behavior among Moroccan adolescents remain limited [1-4]. Moroccan school adolescents do not respect recommendations regarding physical activity [1-4], several researchers have shown the benefits of physical activity [1-4,12, 13]. This study aims to examine the correlational relationships between physical activity levels and sedentary behaviors among Moroccan high school students. Overall, the results of this study highlight significantly negative associations between physical activity levels and sedentary behaviors within the study population.

A significant portion of boys preferred engaging in sports in streets and sports clubs with close friends, consistent with previous findings by El Oirdi et al.[1-4].

Conversely, a significant number of girls participated in physical and sports activities at school or at home, accompanied by classmates or alone, reflecting similar observations made in the Sidi Kacem province [1-4]. Moreover, a notable proportion of adolescents, both boys and girls, preferred engaging in physical activities in the morning, while others had no specific schedule. Statistically significant differences were observed between genders regarding the accompaniment, location, and duration of physical activity, which is consistent with the findings of a previous study by El Oirdi et al. [1-4].

A significant proportion of girls (54.3%) and over a quarter of boys (27.5%) did not meet the recommendation for at least one hour of moderate-intensity physical activity per day. These results are consistent with those of the study conducted in Sidi Kacem, where 48.6% of girls and 23.5% of boys did not meet physical activity recommendations [1-4], although they are higher than those reported among adolescents in Kenitra (9% of boys and 32% of girls) [14] and Taza (50% of boys and 66.6% of girls) [15]. This disparity could be attributed to geographical, socioeconomic, and traditional differences between cities [1]. Key factors contributing to adolescent inactivity in Morocco include short travel distances to schools, limited durations of physical education classes in schools, and declining recreational facilities, while families tend to encourage their daughters less to engage in physical activity [1,2]. Furthermore, boys were more inclined to engage in physical activity than girls [16]. Physical activity levels among adolescents have been widely reported to fall below recommendations in various countries, with Arab girls exhibiting lower physical activity levels than boys across all regions [17]. The recommended sleep duration for adolescents is seven to eight hours per day. Unfortunately, less than half (54.82%) of the adolescents, whether boys or girls, adhered to this recommendation, while nearly 29% slept less than 6.9 hours per day, and approximately 17% slept more than eight hours. These results are consistent with those found by El Oirdi and al [18]. Factors contributing to the increase in sedentary behaviors in Morocco include the proliferation of telecommunication devices such as computers, tablets, and smartphones, as well as the large number of television channels [1-4]. Furthermore, the increasing use of telecommunications compared to television is notable due to the popularity of YouTube channels aimed at adolescents, social networks (Facebook, Twitter, Instagram, WhatsApp), video games, and increased internet accessibility due to competition among telecommunications companies [1-4]. To counteract sedentary behaviors among young people, it is necessary to increase opportunities for physical activity at school and in the community.

Regarding the correlational relationships between levels of physical activity and sleep duration, our study suggested a positive association between total duration of physical activity, energy expenditure in physical activity, and sleep duration, consistent with previous studies highlighting the positive impact of physical activity on sleep quality and duration.

5 Conclusion

The conclusions of this study indicate that individuals who engage in regular physical activity may benefit from extended sleep. It is evident that levels of physical activity and sedentary behaviors are closely linked. Raising awareness among the public about these aspects and promoting the adoption of a more active and less sedentary lifestyle are of crucial importance. Health promotion initiatives, such as exercise programs and policies promoting physical activity, can help reduce the prevalence of sedentary behaviors and improve the overall health of the population. However, further research is needed to understand the underlying mechanisms of this complex relationship and its potential influence by various factors.
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