

# Physical exercise, energy expenditure and tobacco consumption in adolescents from Murcia (Spain)

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## ABSTRACT

**Introduction.** Physical and sports activity is essential for a healthy lifestyle and is considered a prevention factor for several harmful habits on health. The purpose of this study was to establish the relationship between the level of physical activity, energy expenditure and tobacco consumption among adolescent students.

**Population and Methods.** Adolescent students aged 14 to 17 years old from the province of Murcia were included. Their level of physical activity was assessed using the International Physical Activity Questionnaire, and smoking was evaluated using the Youth Risk Behavior Surveillance.

**Results.** Out of 344 adolescents, 20.3% were overweight and 5.8%, obese. Of the total, 44.2% reported being active on a regular basis, while 55.8% were irregularly active or inactive. The level of physical exercise was higher among boys than girls. Tobacco was consumed by 20.3% of the sample, but no significant differences were observed based on sex. The highest energy expenditure from physical activity was positively associated with non consumption of tobacco.

**Conclusions.** Among adolescents, a higher level of physical activity and a higher energy expenditure are positively associated with non consumption of tobacco.

**Key words:** physical activity, energy expenditure, tobacco, obesity, students.

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## INTRODUCTION

At present, the adolescent population faces different health problems, being tobacco consumption and obesity two of the most common. One of the major problems is the increase observed in the prevalence of obesity during adolescence,<sup>1</sup> which is even three times higher in several European Union countries.<sup>2</sup>

The World Health Organization (WHO) considers that obesity will be one of the greatest epidemics of the 21<sup>st</sup> century. Obesity has been associated with several cardiovascular risk factors, such as arterial hypertension, type 2 diabetes mellitus, sleep apnea,

asthma, and increased predisposition to infections.<sup>3</sup>

Adult obesity has been related to childhood and adolescence weight.<sup>4</sup> Although it may have a genetic influence, certain behaviors like a sedentary lifestyle and an unbalanced diet are key factors for adolescent obesity.<sup>5</sup>

Several studies have analyzed obesity in the adolescent population.<sup>6-8</sup> In addition, the increasing consumption of tobacco among youth has raised great public concern over the past years. Although different studies have shown a positive relationship between tobacco consumption and the risk of eating disorders among adolescents,<sup>9,10</sup> and lower body mass indexes than non smokers,<sup>11-13</sup> such relationship can be triggered by other reasons. Investigations on tobacco consumption have confirmed the establishment and development of this legal drug, which has progressively become consolidated as a harmful life habit among adolescents.<sup>6</sup> However, the National Student Survey (State Survey on the Use of Drugs in Secondary Education, ESTUDES),<sup>14</sup> found a reduction of tobacco consumption in adolescent students compared to the data collected in the prior survey.

With respect to such problems faced by adolescents, we believe that adopting an active lifestyle with regular physical exercise is associated with a reduced consumption of toxic substances, including tobacco.<sup>15-17</sup>

Continuous physical activity, together with a balanced diet, contributes to an adequate regulation of body weight and makes the onset of obesity more difficult, both during childhood and adulthood (80% of

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obese adults were obese children).<sup>18</sup> Besides, systematic physical exercise has been related to the prevention of metabolic and cardiovascular conditions.<sup>18</sup> According to the AVENA study,<sup>6</sup> inactivity poses a health risk factor. Different studies have demonstrated a relationship between a low level of physical activity and increased body mass index in adolescents.<sup>19,20</sup> For this reason, physical exercise is considered a basic protective element against obesity, especially the practice of mainly aerobic activities.<sup>21</sup>

The objectives of this study were: 1) to determine the levels of extracurricular physical activity and energy expenditure; 2) to analyze the frequency of tobacco consumption; and 3) to determine the association between the level of physical activity done out of school and tobacco consumption among adolescent students from the province of Murcia.

## POPULATION AND METHODS

### Population

In a population of 5400 adolescent students aged 14-17 years old, a randomized sample was selected out of different school facilities from various locations in the North of the province of Murcia. Selection was based on a stratified and multiple stage process with different sampling units (regions, municipalities, school facilities). Subjects participated in the study from January to May of 2011. Sample selection was based on a 95.5% confidence interval and a margin of error of the estimate  $\pm 5.2\%$ . The sample was selected out of all students enrolled at 3<sup>rd</sup> and 4<sup>th</sup> grades of Obligatory Secondary Education (OSE) and at 1<sup>st</sup> grade of High School.

### Procedure

The study was approved by the Ethics Committee of Universidad de Murcia. Before data collection, permission was obtained from school authorities. In addition, study procedures were informed to parents and students, and their informed consent was obtained.

Questionnaires were self-administered in small groups (25 to 30 students) and adolescents had to complete the items proposed themselves. The process was conducted under the supervision of an investigator.

The International Physical Activity Questionnaire<sup>22</sup> was used to assess the level of physical activity performed.

This questionnaire measures the level of physical activity done by adolescents out of

school and is made up of 4 items. Based on data collected, adolescents were classified into one of the following three categories: inactive (no physical exercise), irregularly active (some sort of physical exercise one to three times a week), and regularly active (physical exercise more than three times a week).

Supported by data obtained in the questionnaire, the weekly energy expenditure was determined (measured in metabolic equivalents/day, MET) using the compendium of energy expenditure associated to different activities.<sup>23</sup>

The Youth Risk Behavior Surveillance,<sup>24</sup> an opinion questionnaire regarding the habit of tobacco consumption in adolescents was used to assess tobacco consumption. It included qualitative, dichotomous and polychotomous items, as well as hierarchical items, to evaluate if adolescents had ever used tobacco, age at initiation and usual consumption. Terms were culturally adapted and the questionnaires were translated from English into Spanish according to the International Test Commission (ITE) recommendations for test design and adaptation.<sup>25,26</sup>

Finally, a 13 item questionnaire was prepared (4 items in relation to physical exercise, 4 items regarding tobacco consumption and 5 items associated with general matters). The questionnaire was first cognitively pretested with a pilot sample of 99 adolescents (41 girls and 51 boys) so as to determine the level of comprehension of the different items, the time required to administer it and any complication with its implementation.

The pilot test results indicated to remove certain items and modify how others were stated. Once corrections were made, the definite version of the questionnaire was prepared and self-administered by participants (*Annex 1*, digital version).

Following the questionnaire administration, height and weight were recorded using a scale and stadiometer (Quirumed model 0072e) with adolescents barefoot and wearing light clothing. For height measurement, they stood standing in the stadiometer. Height was recorded to the nearest millimeter.

Based on height and weight data, their body mass index (BMI) was determined by dividing weight in kilograms by the square of height. Results were categorized into four groups (low weight, normal weight, overweight, obesity) according to international standard cut-off points.<sup>27</sup>

Such cut-off points were established for children and adolescents aged 2 to 18 years old, by sex, with 0.5 points per year and the following values as reference: < 18.5 kg/m<sup>2</sup>, low weight; > 25 kg/m<sup>2</sup>, overweight; and > 30 kg/m<sup>2</sup>, for obesity.

### Data Analysis

Descriptive statistics were obtained using, for categorical outcome measures, numeric and percentage count according to the sample's sex and age. For continuous outcome measures, mean, median and standard deviation values were expressed. Student's *t* test was used for independent samples to determine differences between sexes.

The relationship between categorical outcome measures was determined using contingency tables and Pearson's  $\chi^2$  test with the corresponding residual analysis (with  $p < 0.05$  considered a significant value). Inferential statistics were developed using an analysis of variance (ANOVA) so as to study the relationship between tobacco consumption and energy expenditure in adolescents based on their sex.

### RESULTS

The definite sample was made up of 354 subjects. All students in the classroom on

the day of the questionnaire were surveyed. Out of this sample, 10 adolescents (2.9%) were excluded because they did not complete the questionnaire correctly. Out of the total sample, 20.3% were overweight and 5.8% were obese, with no significant differences observed in terms of gender. *Table 1* shows the sample characteristics. Of all participants, 54.95% were boys and 45.05%, girls. The *t* test for independent samples showed no differences in body mass index by sex. On the contrary, significant differences were observed in weight, height and energy expenditure values.

Data indicate that 80.4% of boys did physical exercise versus 58.1% of girls (*Table 2*).

The  $\chi^2$  test demonstrated that males were significantly more active than females ( $p = 0.000$ ). Conversely, 29.7% of adolescents were physically inactive (19.6% of boys and 41.9% of girls).

Regular tobacco consumption was referred by 20.3% of adolescents (*Table 3*), with no significant differences between genders (19% of boys vs. 21.9% of girls).

Both male and female adolescents considered active were associated with rejection of tobacco consumption (*Table 4*). The  $\chi^2$  test was complemented with the residual analysis and it showed a significant relationship between a regular physical activity and tobacco consumption both in males and females.

TABLE 1. Sample characteristics by sex

	Total	Male	Female	t (p value)
n	344	189	155	
Weight in kg, mean (standard deviation)	63.73 (13.236)	66.91 (14.145)	59.85 (10.879)	26.027 (0.000)
Height in cm, mean (standard deviation)	133.46 (65.968)	140.63 (64.478)	124.72 (66.911)	5.015 (0.026)
BMI, mean (standard deviation)	23.05 (3.990)	22.99 (4.226)	23.13 (3.693)	0.085 (0.771)
Energy expenditure in kcal/week, mean (standard deviation)	1396.57 (1744.334)	1972.41 (1834.196)	694.42 (1329.182)	52.586 (0.000)

BMI: Body mass index.

TABLE 2. Level of physical activity by sex

	Total	Physical activity		
		Inactive	Irregularly active	Regularly active
Total n (%)	344 (100)	102 (29.7)	90 (26.2)	152 (44.2)
Male n (%)	189/344	37 (19.6)	47 (24.9)	105 (55.6)
CTR	(54.9)	-4.5	-0.6	4.7
Female n (%)	155/344	65 (41.9)	43 (27.7)	47 (30.3)
CTR	(54.1)	4.5	0.6	-4.7

CTR: corrected typified residuals:  $\chi^2$ : 26.898;  $p = 0.000$ .

For boys, it was positively associated with those categorized as regularly active ( $p=0.05$ ). For girls, it was associated with those categorized as irregularly active ( $p=0.01$ ).

Mean weekly energy expenditure values in relation to tobacco consumption in adolescents and by sex are presented in Table 5. The analysis of variance showed a significant relationship between weekly energy expenditure and tobacco consumption among boys ( $p=0.031$ ). Male adolescents with a higher energy expenditure smoked less, and these data were confirmed by the Student's  $t$  test value (-5,11) and by the size of the relationship with a  $R=0.65$ . Such relationship was not observed among girls.

TABLE 3. Tobacco consumption by sex

	Total	Tobacco consumption	
		Smoker	Non smoker
Total $n$ (%)	344 (100)	70 (20.3)	274 (79.7)
Boy $n$ (%)	189/344	36 (19)	153 (81)
CTR	(54.9)	-0.7	0.7
Girl $n$ (%)	155/344	34 (21.9)	121 (78.1)
CTR	(54.1)	0.7	-0.7

CTR: corrected typified residuals;  $\chi^2: 0.438$ ;  $p = 0.298$ .

TABLE 4. Association tests (Pearson's  $\chi^2$  complemented with a residual analysis) that relate regular physical exercise with tobacco consumption

Related outcome	Male						Female							
	Regular smoker			Total	$\chi^2$	p	Regular smoker			Total	$\chi^2$	p		
	Yes (n/%)	CTR	No (n/%)				CTR	Yes (n/%)	CTR				No (n/%)	CTR
Inactive	12 (6.3%)	2.3	25 (13.2%)	-2.3	37		23 (14.8%)	3.4	42 (27.1%)	-3.4	65			
Irregularly active	9 (4.8%)	-0.0	38 (20.1%)	0.0	47	5.843	0.050	2 (1.3%)	-3.2	41 (26.5%)	3.2	43	14.581	0.001
Regularly active	15 (7.9%)	-1.9	90 (47.6%)	1.9	105			9 (5.8%)	-0.6	38 (24.5%)	0.6	47		
Total	36		153		189			34		121		155		

N: subject frequency; %: percentage; CTR: corrected typified residues.

$\chi^2$ : Pearson's chi-square.

TABLE 5. Relationship between weekly energy expenditure from physical exercise and tobacco consumption

Related outcome	Weekly energy expenditure									
	Male					Female				
	n	Mean	F	t	p	n	Mean	F	t	p
Smoking	36	1381.4				34	842.03			
			4.708	-5.11	0.031			0.536	0.732	
No smoking	153	2111.46				121	652.42			5

Energy expenditure: kcal/week; F: Snedecor's statistics.

## DISCUSSION

The purpose of this study was to establish the relationship between the level of physical activity, energy expenditure and tobacco consumption among adolescent students.

Regarding the level of physical exercise, results show that 44.2% of participants can be categorized as physically active (doing exercise more than 3 times a week) and that most of these were boys (55.6% of boys vs. 30.3% of girls).

By comparison, these data are similar to those obtained in the OPACA study<sup>28</sup> (74% of exercise practice) and those detailed by Thibault, et al.,<sup>29</sup> which indicated that 73.8% of adolescents did physical activities (80.8% of men and 66.8% of women).

However, these values are higher than those obtained in other studies. For example, the AVENA study<sup>6</sup> found that 59.2% of adolescents were considered physically active (71.1% of boys and 46.7% of girls). Villagrán, et al.<sup>30</sup> observed a physical activity index of 58.8% (71.7% among boys and 46% among girls). Likewise, Robles, et al.<sup>31</sup> demonstrated that 61.7% of adolescents stated to have done some kind of physical activity out of school (78.8% of boys and 44.6% of girls).

Although there are other studies that have

analyzed the level of physical activity in Spanish adolescent students,<sup>6,28,32</sup> the use of different methodologies renders the possibility of a comparison difficult.<sup>8</sup>

Another outcome measure analyzed in this study was tobacco consumption. Data indicate that 23% of the surveyed adolescents smoked regularly (smoking at least one cigarette in the past 7 days), with a slightly higher consumption observed among girls, although no significant difference was observed from boys.

The National Student Survey<sup>14</sup> shows a trend towards the reduction of tobacco consumption among students; 32.4% of adolescents had smoked in the past 12 months. Our data indicate lower values than those obtained by Mulassi, et al.<sup>33</sup> who observed that 29.3% of students had smoked in the past month (25.2% of boys compared to 32.6% of girls).

The BMI was used in order to establish the presence of overweight or obesity.

Our data indicate that 20.3% of adolescents were overweight, while 5.8% were obese, with no significant differences observed in terms of gender. These data are consistent with those of the studies by Villagrán, et al.,<sup>30</sup> who found that 28.6% of students were obese (24.4% of boys and 32.9% of girls). However, these data are slightly lower than those obtained in the study by Martínez, et al.,<sup>8</sup> where 30.5% of students were found to be obese, and than those indicated by an international study conducted in 34 countries in 2005,<sup>34</sup> where the data corresponding to Spain established that 29% of adolescents were obese. As a matter of fact, the data obtained in this study indicate higher values than those obtained among French adolescents,<sup>29</sup> with 13.6%.

The analysis of the relationship between doing physical exercise and consuming tobacco in adolescents found a trend to non smoking among those who were physically active. In accordance with national<sup>8,30</sup> and international<sup>16,17</sup> studies, active adolescents smoke less. In this study, 85.9% of active adolescents indicated that they did not smoke, compared to 66% of non active adolescents. In this sense, Aleixandre, et al.,<sup>15</sup> (2005) found that adolescents who stated doing sports had a 59% lower consumption of tobacco than those who did no physical exercise, i.e., a tobacco consumption 20 times lower in terms of number of cigarettes smoked per week.

Lastly, Halperin, et al.,<sup>17</sup> (2010) found that in a study with 10 000 American university students, any level of tobacco consumption was associated

with a lower level of physical activity. University students who used to do physical exercise three or more times a week smoked less than those who did so less than three times a week.

A relevant aspect of this study is the difference found when analyzing energy expenditure of adolescents and their relationship with tobacco consumption. Accordingly, it has been observed that physically active adolescents are associated with non smoking. However, such relationship is not evident among girls. In this sense, we observed how other studies<sup>6,10,13,15</sup> that investigated the relationship between physical exercise and tobacco consumption did not analyze the energy expenditure of such exercise in adolescents. Our data indicate that adolescents students associated with non smoking had a higher energy expenditure than those who did smoke. In this regard, no significant difference was found by Bradley, et al.<sup>13</sup> (2010) regarding total energy expenditure when comparing male and female adults who smoked and who did not smoke.

Given the relationship between the level of physical activity and energy expenditure and not consuming tobacco during adolescence, we believe it is necessary to implement sports promotion policies that encourage participation in physical activities. Likewise, we consider that it would be very interesting to develop health education programs at schools that equally approach adolescents' eating habits, level of physical activity and tobacco consumption. Such intervention should be prioritized in the case of girls given that they make up the group where tobacco consumption is most emergent and also the ones who do less physical exercise.

## CONCLUSIONS

Significantly higher levels of physical exercise were observed in boys compared to girls, and both male and female adolescents have shown a significant association between the level of physical activity and not consuming tobacco. Only boys demonstrated a significant association between the energy expenditure resulting from physical exercise and not consuming tobacco. ■

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## Annex 1

The following questions are related to tobacco consumption.

We expect you to answer all questions.

1. How many of the people you know smoke on a regular basis? (indicate as many as you think necessary)

- My father
- My mother
- My siblings
- My boyfriend/girlfriend
- My friends

Others (indicate who).....

2. Have you ever smoked tobacco? (cigarettes, cigar or pipe; smoking means at least one cigarette, cigar or pipe, not just a puff or trying it)

- Yes
- No

If you answered "No," skip to question 5

3. At what age did you have your first cigarette? (cigarettes, cigar or pipe; smoking means at least one cigarette, cigar or pipe, not just a puff or trying it)

..... years old

4. In the past 30 days, how often have you smoked?

- 0 days
- 1-2 days
- 3-5 days
- 6-9 days
- 10-19 days
- 20-29 days
- 30 days

Below you will find a series of issues related to regular physical activity you do in your daily life.

**Sports:** "Sports" is defined both as physical activity (aerobics, footing, muscle-building, etc.) and sports (soccer, basketball, swimming, etc.) done out of school.

### REGULAR PHYSICAL ACTIVITY

5. In the past 7 days, how often have you done intense physical exercise?

..... days

If you answered "NO," skip to question 9

6. What sports or physical activity is it?

.....

7. How often do you practice it on a weekly basis?

- 1-2 days
- 3 days
- 4 days
- 5 or more days

8. Approximately how many hours a day do you devote to practicing it?

- 30 minutes
- 30 minutes-1 hour
- 1-2 hours
- More than 2 hours

The following questions are related to some basic characteristics about you and your immediate environment.

We expect you to answer all questions.

9. What is your sex?

- Man
- Woman

**10. How old are you?**

.....years old

**11. What grade are you in?**

3<sup>rd</sup> OSE

4<sup>th</sup> OSE

1<sup>st</sup> High School

**12. How much money do you have available every week?**

Less than 10 Euros

10-15 Euros

15-20 Euros

More than 20 Euros

**13. At present, are you a member of a sports club?**

Yes

No

**THANK YOU FOR YOUR HELP**