Chauvet, M.; Martín-Escudero, M.P.; Martínez-de-Haro, V. y Cid-Yagüe, L. (2018). Actividad física y hábito tabáquico en estudiantes adolescentes / Physical Activity and Smoking Habit in Adolescent Students. Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. 18 (69) pp. 151-164. Http://cdeporte.rediris.es/revista/revista69/artactividad873.htm
DOI: https://doi.org/10.15366/rimcafd2018.69.010

ORIGINAL

PHYSICAL ACTIVITY AND SMOKING HABIT IN ADOLESCENT STUDENTS

ACTIVIDAD FÍSICA Y HÁBITO TABÁQUICO EN ESTUDIANTES ADOLESCENTES

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Código UNESCO / UNESCO code: 3212 Salud Pública / Public Health
Clasificación Consejo de Europa / Council of Europe Classification: 17 Otros (Actividad Física y Salud) / Others (Physical Activity and Health)

Recibido 7 de septiembre de 2015 **Received** September 13, 2015
Aceptado 29 de diciembre de 2015 **Accepted** December 29, 2015

ABSTRACT

The aim of the study was to detect how physical education and smoking habits affect secondary school students, 168 non smokers and newly initiated were studied. Weight, height, heart rate, blood pressure, physical activity, strength, flexibility and endurance, and spirometric tests were analyzed. In both, female and male smokers, obtained worse results in the mayority of spirometric parameters (FEV_1, $FEF_{25-75\%}$, FVC) and premature lung ageing, more pointed in females. Moderate physical-sporting activity is associated to adolescents who smoke less and quit smoking more easily.

KEYWORDS: Adolescent, students, health, smoking habit, spirometry, motor activity.

RESUMEN

El objetivo de este estudio fue detectar en qué medida afecta la actividad

física y el hábito tabáquico en estudiantes de Enseñanza Secundaria. Se estudiaron 168 adolescentes no fumadores y fumadores recién iniciados. Se midieron peso, talla, presión arterial, frecuencia cardíaca, actividad física, fuerza, flexibilidad y resistencia y una prueba espirométrica. Tanto en chicas y chicos fumadores, se evidenciaron peores resultados en la mayoría de los parámetros espirométricos (FEV_1, $FEF_{25-75\%}$, FVC) y un envejecimiento prematuro del pulmón, más acentuado en chicas. La actividad físico-deportiva moderada se asocia a adolescentes que menos fuman y tienen más facilidad para abandonar el hábito tabáquico.

PALABRAS CLAVE: adolescente, estudiantes, salud, hábito de fumar, espirometría, actividad motora.

INTRODUCTION

Smoking cigarettes is a widespread and dangerous behavior for health (Prokhorov, A, Pallonen, V, Fava, J, & Niaura, L, 1996).

The smoking habit is being more and more acquired at earlier ages in the Spanish population (Tercedor, P et al., 2007); its harmful effects may be affecting, on the one hand, habits related to the practice of physical-sport activities (Samet, J, 2002)and, on the other hand, certain functional parameters (Kohansal, Martinez-Camblor, Agustín, Buist, Mannino & Soriano, 2009; and Prokhorov, Emmons, Pallonen & Tsoh, 1996a); and, therefore, these effects may also be limiting, if not decreasing, levels of physical fitness, factors closely linked to health (National Institutes of Health, 1995).

There is scant specific research to assess adolescent smoking habit acquisition and the effect of participation in sports and the association as an element to cushion the effects of genetic predisposition on smoking progression in adolescence (Audrain-McGovern et al., 2006). In addition, the possible effect on their lung function after exposure to tobacco smoke in adolescents is unknown (Suárez López de Vergara et al., 2007).

Some researchers attribute to physical activity a direct and negative effect on smoking progression in adolescents (Audrain-McGovern, Rodríguez & Moss, 2003, and Pate, Heath, Dowda & Trost, 1996). Other authors point to a different direction and emphasize that physical-sport activities have a positive relationship with substance use among young people (Moore & Werch, 2005; Ford, 2007; and Bergamaschi, Morri, Resi, Zanetti & Stampi, 2002).

The growing understanding of how physical activity affects physiological function supports the recommendations of certain practices. The body responds to physical activity with important positive effects on the musculoskeletal system, cardiovascular and respiratory systems and endocrine systems. These changes are consistent with a number of health benefits, including reduced risk of premature mortality and reduced risk of coronary heart disease,

hypertension, colon cancer and diabetes mellitus (US Department of Health and Human Services [USDHHS], 2006).

With the goal of encouraging greater participation in physical activity among Americans of all ages, a group of experts formulated a public health recommendation on the types and amounts of physical activity needed for health promotion and disease prevention. The US Department of Health and Human Services concluded that people of all ages can improve the quality of their lives through a lifetime physical activity practice preferably every day, performing 30-45 minutes of brisk walking, biking, or even working around the house or yard (USDHHS, 1996). The 2007 update clarified that "in order to promote and maintain health, all healthy adults between the ages of 18 and 65 need a moderate-intensity aerobic physical activity (endurance) with a minimum of 30 minutes, five days a week or a vigorous-intensity aerobic physical activity for a minimum of 20 minutes, three days a week (Haskell et al., 2007). Scientifically grounded studies in the field of physical activity have focused almost exclusively on adults, with a great lack of knowledge regarding the stage of adolescence.

The idea that there was a direct relationship between the amount of physical activity (more physical activity, better health) and health benefits is currently questioned (Pérez Samaniego & Devís Devís, 2003).

Several authors agree on the fact that sedentary subjects are the ones who smoke the most compared to the most active ones (Castañeda Vázquez, C & Romero Granados, S, 2014; Peltzer, K, 2010; Pérez Samaniego, V & Devís Devís, J, 2003; Rainey, C, McKeown, R, Sargent, R, & Valois, R, 1996; Rodríguez-Romo, G et al., 2010; Vaquero-Cristóbal, R, Isorna, M, & Ruiz, C, 2013) and from the perspective of health, the observation of a significant association between low physical activity and smoking cigarettes is particularly important importante (Pate, R, Heath, G, Dowda, M, & Trost, S, 1996; Rodríguez-Romo, G et al., 2010). Therefore, physical activity has a direct and negative effect on smoking progression, which suggests that it may protect against the progression of smoking in adolescents (Audrain-McGovern, Rodríguez & Moss, 2003; and Pate et al. 1996), although the relationship between consumption and physical activity also depends on the type of sport (Peretti-Watel, Beck & Legleye, 2002). However, students who are extrinsically motivated by their participation in physical-sport activities, and particularly those involved in team sports, are more prevalent in the use of harmful substances (Rockafellow & Saules, 2006), since those sports have some characteristics, such as social activity, which may increase the risk of young people consuming tobacco and other drugs (Wichstrøm & Wichstrøm, 2009). On the contrary, an investigation carried out in Spain concluded that neither the practice of sports (either individual or collectively) nor the purpose of competing (with or without a competitive character) seem to be related to tobacco consumption (Caracuel, R et al., 2017; Ruiz-Juan, F, de la Cruz-Sánchez, E, & García-Montes, M, 2009) although other investigations found that the regular practice of physical-sport activity is positively related with a lower frequency of tobacco consumption (Rodríguez García, López Villalba, López Miñarro & García Cantó, 2013).

Tobacco consumption has been known to have health risks, especially when it is started in a very young stage, and particularly when adolescents start smoking daily at an early age, since it leads to a long-term increased risk of addiction to nicotine (Vaquero-Cristóbal, R et al., 2013; Weiss, R et al., 2008).

The objective this study, within a wider investigation was to know if physical activity influences in some way to prevent smoking, as well as the influence of smoking and the practice of physical-sport activities on adolescents. Attempts were made to determine the type of physical activity associated with abstinence and lesser degree of smoking.

METHOD

This study responds to a "non-experimental quantitative research". The sampling method used was the non-probability incidental sampling technique.

Sample

The sample affected all the students of fourth of CSE and first year of Baccalaureate of a Highschool in Tres Cantos of Madrid (Spain), a total of 168 subjects (85 girls and 83 boys) between 14 and 18 years old (= 16.1 years ± 0.79).

We measured somatometric and functional parameters at rest (weight, height, blood pressure [BP], heart rate [HR]), strength (manual dynamometry), flexibility (Sit and Reach test) and after carrying out a submaximal exercise protocol to assess cardiorespiratory fitness (Cooper test), functional parameters were again measured in different recovery periods (at the end of the first, second, third and fifth minute of completion) and a forced spirometry test was performed using the criteria of the American Thoracic Society and SEPAR (FVC, FEV_1, FEV_1 / FVC, PEF, $MEF_{50\%}$, $FEF_{50\%-75\%}$, FEV_1/PEF, Lung age [SEPAR equation]). BMI was also recorded, maximal oxygen consumption (2 max) and whenever possible variables were changed to find functional capacity values (Cooper test score, 2 max. indirect, PA classification, and others). To measure physical activity, the questionnaire of the UCM was given to the subjects to be filled in (Martín Escudero y Moneva Vicente, S.P.)

Tools

Test and protocols were those recommended internationally.

Physical activity was measured by a questionnaire designed by the *Universidad Complutense de Madrid* (UCM) (obtaining scores between 0 and 28 points), which was validated, allowing two types of grouping of subjects according to the degree (intensity) of physical-sport activity.

Thus in Group I, two categories were defined:
(a) No activity and low physical activity (0 to 7 points [p.]), and
(b) Moderate and intense physical activity (8 to 28 p.).

In Group II, four categories were defined:
(a) No physical activity (0 p.),
(B) Low physical activity (1 to 7 p.),
(C) Moderate physical activity (8 to 14 p.) and
(D) Intense physical activity (15 to 28 p.).

The evaluation of nicotine dependence was evaluated by the Fagerström test (Clemente Jiménez, Rubio Aranda, Marrón Tundidor, Herrero Labarga, Mejía Escolano & Cascán Herreros, 2002). The motivation to quit smoking was assessed by the Richmond Motivation Test (Ramos Pinedo & Prieto Gómez, 2004) and the type of smoker by the Glover-Nilsson test (Barrueco Ferrero, Hernández Mezquita, Torrecilla García, 2009).

The grouping of subjects regarding smoking was adjusted to the attitude towards smoking in "non-smoker" and "smoker"; and depending on the dependence on nicotine in "non-dependent", with "low", "moderate" and "intense" dependence.

The investigation respected the Declaration of Helsinki (World Medical Association, 2001) and fulfilled the mandatory aspects developed in the Organic Law of protection of personal data (LOPDCP 15/1999, of December 13). Students were asked to participate voluntarily and freely, and informed consents were requested from the parents or guardians of the participants.

Procedures

Field tests coincided in mornings in the same hour range and in common places, so that it was unlikely to have effects of “selection”, and “interaction between selection and maturation”.

Special care was taken to ensure that the students, when completing the questionnaires and when carrying out the tests, they did so by preserving the highest equality between the groups, keeping the same aspects concerning the practical development, the same instructions and the same room, which had similar characteristics (furniture, temperature and ventilation). They were informed of the anonymity of the questionnaires.

For the statistical procedure SPSS® software, version 19.0 was used. A debug phase, data quality control and descriptive statistics were applied. Quantitative and qualitative data analysis was started with normality tests, correlations (Pearson and Spearman), grouping 45 and 58 quantitative and qualitative variables according to their type in six sections and contingency tables. The comparison of two groups was done with Chi-square, Student t-test and for more than two groups ANOVA and Kruskal-Wallis Test. For processing punctual data, we used personalized Tables and linear relationship verification through regression.

RESULTS

The "aging" of the pulmonary age was quantified (SEPAR equation) $\bar{X}$ = 1.44 years, with decrease in FEV_1 (49 mL) and in $FEF_{25-75\%}$ (104 mL) in male smokers and reduction in FVC (38 mL) in non-smokers.

When the subgroups of non-smokers and smokers were analyzed, the difference of the lung age increased according to the equation SEPAR ($\bar{X}$ = 2.09 years), and greater reductions were found in FEV_1 (91 mL) and in $FEF_{25-75\%}$ (232 mL) in smokers and decrease in FVC (47 mL) in non-smokers. In addition, the subgroup of non-smokers obtained higher means in *flexibility* ($\bar{X}$ = 27.6 cm, vs. $\bar{X}$ = 27.1 cm); *strength* ($\bar{X}$ = 37.4 kgf vs. $\bar{X}$ = 37.3 kgf) and *endurance* ($\bar{X}$ = 2,334 m vs. $\bar{X}$ = 2,197 m) (non-significant differences).

The female group recorded a difference in pulmonary age, $\bar{X}$ = 0.98 years of aging in smokers with a decrease in FVC (107 mL) and in FEV_1 (44 mL) and in non-smokers with a reduction in $FEF_{25-75\%}$ (29 mL) . In the study of the subgroups of non-smokers and smokers, the difference in lung age was found to be $\bar{X}$ =3.64 years, and a reduction was found in FVC (262 mL), FEV_1 (163 mL) and $FEF_{25-75\%}$ (10 mL) in smokers. Also non-smokers recorded better *endurance* ($\bar{X}$ = 1,944 m, vs. $\bar{X}$ =1,863 m) and in points obtained in the physical activity questionnaire ($\bar{X}$ = 17.8 and $\bar{X}$ = 12.8 points) (p = 0.06), while the smokers obtained in *flexibility* $\bar{X}$ = 35.4 cm vs. $\bar{X}$ = 34.5 cm and in *strength* $\bar{X}$ = 26.4 kgf vs. $\bar{X}$ = 25.7 kgf (non-significant differences).

TABLE I. Average cigarettes/day by Group II (physical activity in smokers)

Average cig/day	***Group II (Smoker - Male)***												Total	% Total
	No act.	% Relat [1]	% Total	**Low act.**	% Relat.	% Total	**Moderate Act.**	% Relat.	% Total	**Intense Act**	% Relat.	% Total		
≥ 0.1 a ≤ 5	1	14.3	3.1	3	37.5	9.4	5	41.7	15.6	3	60.0	9.4	12	37.5
≥ 5 a ≤10	3	42.9	9.4	3	37.5	9.4	4	33.3	12.5	1	20.0	3.1	11	34.4
> 10	3	42.9	9.4	2	25.0	6.3	3	25.0	9.4	1	20.0	3.1	9	28.1
Total	7	100	21.9	8	100	25	12	100	37.5	5	100	15.6	32	100
Group II (Smoker - Female)														
≥ 0.1 a ≤ 5	3	75.0	13.0	6	46.2	26.1	2	100	8.7	2	50.0	8.7	13	56.5
≥ 5 a ≤10	1	25.0	4.3	2	15.4	8.7	0	0.0	0.0	2	50.0	8.7	5	21.7
> 10	0	0.0	0.0	5	38.5	21.7	0	0.0	0.0	0	0.0	0.0	5	21.7
Total	4	100	17.4	13	100	56.5	2	100	8.7	4	100	17.4	23	100

[1]Relative

There was no significant association between the psychological, social and gestural dependence on tobacco (Test Glover-Nilsson) and the variable physical activity.

An inverse relationship was found between the average cigarette/day and the motivation to quit smoking (Richmond test) (r = -0.462, p = 0.01). There was also a negative association between physical dependence on nicotine (Fagerström test) and motivation to quit smoking (r = -0.504, p = 0.01). The association between physical activity and the motivation to quit smoking reported an r = -0.061.

We found female smokers with a consumption of 1 to 5 cig/day in all categories of physical activity (Table I), those who consumed 6 to 10 cig/day were distributed but in a lower percentage, finding no case in moderate physical activity. With a higher consumption of 10 cig/day only cases of low physical activity were described. The boys were distributed in all types of physical activity with different consumptions, in greater proportion in moderate activity, and lower percentage in intense activity.

In Table II, all correlations are analyzed and have been grouped into six sections according to the origin of the variables.

Once the zero-order correlations of male section 1 (non-exposed) were obtained, correlations were again found, but this time using the variable Physical activity as the control variable (points obtained in the physical activity questionnaire of the UCM). Here, only 102 correlations (62.2% of the total) were analyzed, observing 33 significant correlations and four other correlations that lost their significance. These data are of particular interest because they are influenced by Physical Activity to correlate significantly. The second control focused on “smoking time”, losing significance in 33 correlations, which indicated the high influence of the factor time consuming tobacco. The third and final control was performed with the "average of smoked cigarettes/day ", in other words, the intensity of the consumption, finding only two losses of significance, which indicate little influence on the control variable. The process was repeated for the female group and for the remaining sections. At the end of the table (totals) the summations were obtained, noting that physical activity had little influence in both sexes, a little more influence was manifested in the intensity of tobacco consumption, with a higher number of losses of statistical significance and finally the smoking time was the most influential of the three analyzed factors.

Male and female physical activity was higher in non-smokers ($\overline{X}$ = 18.6 and $\overline{X}$ = 17.3 points) and lower in smokers ($\overline{X}$ = 16.5 and $\overline{X}$ = 13.6 points) (non-significant differences).

There was also a lower intensity of smoking when physical-sport activity increased.

TABLE II. Partial correlations. Subtotals and Totals

Matrix dimension (Dm) = 4*41 [1] N. Var. (V) = 164 [2]	Personal data and Somatometric Parameters												
	Male Sexual Phenotype							Female Sexual Phenotype					
	Control Variables												
	Phy.Act [51]	**%**	**Smoking time [44]**	**%**	**Average cig/d (T) [45]**	%		**Phy.Act [51]**	**%**	**Smoking time [44]**	**%**	**Average cig/d (T) [45]**	**%**
Total selected corr,	102 (62.20 %)							86 (52.44 %)					
N. sign.corr. [4]	33	20.12	7	4.27	40	24.39		27	16.46	4	2.44	33	20.12
N corr. lost sig. [5]	4	2.44	33	20.12	2	1.22		1	0.61	24	14.63	0	0.00
N corr. acquire Sig.[6]	0	0.00	2	1.22	2	1.22		1	0.61	1	0.61	6	3.66

Dm 6*41 = 246 V.	Fitness Tests												
Total selected corr,	183 (74.39 %)				180 (73.2 %)			153 (62.20 %)					
N. sign.corr. [4]	68	27.64	22	8.94	50	20.33		36	14.63	7	2.85	44	17.89
N corr. lost sig. [5]	0	0.00	33	13.41	4	1.63		2	0.81	34	13.82	3	1.22
N corr. acquire Sig.[6]	18	7.32	3	1.22	7	2.85		0	0.00	0	0.00	6	2.44

Dm 9*41 = 369 V.	Cardiovascular Parameters												
Total selected corr,	224 (60.70 %)							171 (46.34 %)				162 (43.9 %)	
N. sign.corr. [4]	53	14.36	13	3.52	49	13.28		45	12.20	13	3.52	51	13.82
N corr. lost sig. [5]	3	0.81	37	10.03	9	2.44		0	0.00	32	8.67	0	0.00
N corr. acquire Sig.[6]	7	1.90	0	0.00	8	2.17		0	0.00	0	0.00	5	1.36

Dm 12*41 = 492 V.	Spirometric Parameters												
Total selected corr,	366 (74.39 %)				354 (72.0 %)			414 (84.15 %)					
N. sign.corr. [4]	120	24.39	52	10.57	101	20.53		92	18.70	48	9.76	105	21.34
N corr. lost sig. [5]	5	1.02	55	11.18	9	1.83		1	0.20	41	8.33	4	0.81
N corr. acquire Sig.[6]	18	3.66	0	0.00	6	1.22		1	0.20	0	0.00	13	2.64

Dm 10*41 = 410 V.	Smoking habit												
Total selected corr,	225	54.88	223	54.39	186	45.37		270 (68.85 %)				233 (56.8 %)	
N. sign.corr. [4]	69	16.83	38	9.27	46	11.22		26	6.34	17	4.15	58	14.15
N corr. lost sig. [5]	1	0.24	32	7.80	13	3.17		6	1.46	17	4.15	6	1.46
N corr. acquire Sig.[6]	2	0.49	3	0.73	6	1.46		2	0.49	1	0.24	31	7.56

Dm 2*41 = 84 V.	Physical Activity												
Total selected corr,	80 (95.24 %)		82 (97.62 %)					80 (95.24 %)		82 (97.62 %)			
N. sign.corr. [4]	18	21.43	5	5.95	12	14.29		7	8.33	5	5.95	10	11.90
N corr. lost sig. [5]	0	0.00	13	15.48	0	0.00		4	4.76	8	9.52	4	4.76
N corr. acquire Sig.[6]	0	0.00	0	0.00	0	0.00		1	1.19	0	0.00	2	2.38

Dm 41*41 = 1681 V.	TOTALS												
Total selected corr,	1100	65.44	1098	65.32	1046	62.22		1094	65.08	1094	65.08	1048	62.34
N. sign.corr. [4]	343	20.40	132	7.85	286	17.01		226	13.44	89	5.29	291	17.31
N corr. lost sig. [5]	13	0.77	190	11.30	37	2.20		10	0.59	148	8.80	13	0.77
N corr. acquire Sig.[6]	45	2.68	8	0.48	29	1.73		4	0.24	2	0.12	61	3.63

[1]Dimension of the matrix [Dm]: In the section of Personal Data and Somatometric Parameters it is equivalent to 4 variables associated to the corresponding section (4 columns) multiplied by the total number of analyzed variables N = 41 variables (41 lines) (matrix = 4 * 41 variables).
[2] Number of Variables [V]: In Number of Variables the total of variables corresponding to the respective matrix is specified (4 * 41 variables = 164 variables).
[3]Total of selected correlations: 102 (62.20%). In this section, the total of selected correlations rises to 102 from a total of 146, which means 62.20% of the total.
[4]Number of significant correlations found.
[5]Number of correlations that lost their significance after controlling a third variable.
Section 6, Physical Activity, is not shown in Totals since it is implicit in the other sections.

CONCLUSIONS

The data of this study suggest that physical activity between female non-smokers and smokers, (less physical activity in smokers), could be interacting negatively by lowering the desired minimum values for muscle strength, which added to a probable lower growth of the lung and the consequence of cigarette smoke leads to reductions in the spirometric parameters FVC, FEV_1 and $FEF_{25-75\%}$.

Although the differences found were not significant, both in male and female smokers, worse results in most of the spirometric parameters and a premature aging of the lung were shown, more pronounced in girls.

The data from this study regarding lung function are worrying, and they warn about the premature power of tobacco to induce an abnormal response in the body of the adolescent.

These findings are similar to the results obtained by other researchers who support that smoking is associated with significant negative effects on cardiopulmonary function and exercise tolerance (Louie, D, 2001; US Department of Health and Human Services, 1994). It has also been noted that smoking reduces lung function by manifesting early airflow obstruction (Taylor, Poulton, Moffitt, Ramankutty & Sears, 2000).
The inverse relationship between cigarette smoking and the motivation to quit smoking (Richmond Test), and physical dependence on nicotine (Fagerström Test) show a willingness to quit smoking, but limited to subjects who smoke with less intensity and therefore are less dependent on nicotine. It is concluded that adolescents who smoke more intensively and those who are more dependent on nicotine are the most unmotivated to quit.

Physical activity, not related to the motivation to quit smoking, could show the absence of the preventive factor expressed in the lack of motivation to quit smoking once the habit is started. It is concluded that physical activity influences little on the motivation to quit.

The lack of a significant association between the psychological, social and gestural dependence on tobacco (Test Glover-Nilsson) and physical activity shows that this does not condition the smoker's typology.

Physical activity is higher in the subgroup of nonsmokers and lower in the subgroup of smokers. However, the study of correlations determined that physical activity has minimal influence on associations with smoking, followed by the intensity of consumption, being the time coexisting with the habit of smoking, or what is the same the time smoking daily, the most influential factor of the three regarding smoking. In a recent research with university students and in support of our findings, they concluded that there is no consistency between the practice of physical-sporting activities and the positive effects that could be generated in the various behavior related to health (Castañeda Vázquez, C & Romero Granados, S, 2014).

In boys there was evidence that among those who practiced physical activities and sports with moderate and intense intensity, 100% abandoned the smoking habit; those with the firm conviction of making a serious attempt to stop smoking reported a relationship of 7-1; there were also boys willing to participate in smoking cessation teams with a relationship of 6-1; and finally, in this subgroup it is more feasible to detect a non-smoker and at the same time to find a lower incidence regarding daily smokers. When Group II was analyzed, there was a higher relative percentage of smokers with a lower intensity of consumption (0.1 to 5 cig / day) and a lower percentage of subjects with high consumption (which implies less dependence on nicotine) with moderate and intense physical-sports. In a study conducted with Asian University Students, a relationship was found within certain parts of Asia between intense physical activity and a smoking habit (Seo, D-C et al., 2014).

In girls, the highest percentages of nicotine dependence are found in the subgroup without physical activity and with low physical activity, because it includes more smokers; and in the subgroup with moderate and intense physical activity are both the experimental smokers and the non-smokers. The analysis of Group II determined that the intensity of consumption and the smoking time did not differ with respect to the type of physical-sport activity, although the smallest number of smokers was in the subgroup with moderate physical activity and the greatest number of smokers with higher intensity of consumption was recorded in the subgroup of low physical activity.

Therefore it is concluded that moderate physical-sports activity is associated with adolescents who smoke less and are more likely to quit smoking.
The present study has some limitations that must be considered in the interpretation of the results. These include the bias produced by students who did not participate in the study, and the questions related to tobacco consumption may present some bias associated with the conditioning of "socially accepted" responses. Finally, health habits are multifactorial, and the study focused on smoking and physical activity, obviating other indicators such as food or the consumption of alcohol, cannabis or other prohibited substances.

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