ORIGINAL ARTICLE

Correlation between physical activity and sedentary behavior with healthy and unhealthy behaviors in Italy and Tuscan region: a cross sectional study

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Key words

Physical health status • Quality of peer relationships • Health complaints

Summary

Introduction. *Regular physical activity (PA) has associated with various positive health aspects such as a decreased risk of chronic or generic illnesses, furthermore, a sedentary lifestyle has been associated with health problems such as obesity. To examine the relationship between patterns of PA, screen-based media use (SBM) and social health indicators within a specific demographic group and highlight the regional vs. national differences in these relationships.*
Methods. *The data is drawn from the Health Behaviour in School-Aged Children (HBSC) database, a national cross-sectional survey in a representative sample (N = 3920) of students aged 11-13-15 years and compared to those of the Tuscan region (N = 3381). Variables considered other than PA and SBM use includes positive health indicators such as physical health status, quality of family and peer relationships, fruit consumption, breakfast consumption as well as negative health indicators, such as health complaints, smoking and alcohol use.*

Results. *Some positive health indicators showed a positive correlation with PA. Students adopting healthy behaviours often met the Physical Activity Guide Line (PAGL). On the contrary, negative health indicators were associated with PAGL in a negative way.*
In general SBM was positively related to several of the negative health indicators and vice versa.
SBM was related in a positive fashion to tobacco use that represents a protective factor.
Discussion. *The results show that met PAGL is associated with positive health indicators and that high levels of SBM use is associated with negative health indicators. The study also emphasizes the relationship between PA, SBM use and social factors. Increasing PA and decreasing SBM use should be an aim in general health behaviour promotion.*

Introduction

Regular physical activity (PA) has been associated with various positive health aspects such as a decreased risk of chronic or generic illnesses: coronary heart disease, obesity, cancer, type 2 diabetes, sexual dysfunction and cognitive impairment [1, 2].

There has been evidence that the inclusion of regular PA as part of a healthy lifestyle is related in a positive way to other health indicators such as perceived health status [3, 4], self-image [4-8], quality of life [9], and quality of peer relationships [10, 11].However, the extent of influence of the family on PA [12, 13] and the potential relationship of adolescent PA to quality of family relations has not been investigated.

Furthermore, a sedentary lifestyle has been associated with health problems such as obesity. In fact, research shows that prolonged hours spent watching TV or playing computer games has a direct impact on the level of daily energy expenditure and as such, it has been suggested that a causal relationship between sedentary behaviors and obesity exists [14].

The primary mechanism for overweight is an imbalance between energy intake and expenditure. Excess sedentary behaviour contributes to one side of this equation [15, 16]. There is also evidence that the effects of sedentary behaviour accumulates over the course of childhood [17]. It appears that sedentary contributes to weight status independently of the PA level [16, 18].

The relationship between PA and negative health indicators such as health complaints, physical aggression, or alcohol abuse has not been sufficiently studied. Currently there is some evidence that suggests that the participation in sports activities might be related to certain health risk behaviors [19-22]. To the contrary there is also evidence that shows that PA is not related to physical aggression [23, 24], smoking [21, 25-27] and alcohol use [12, 21, 25]. Moreover, it has emerged that PA involvement in adolescents may help prevent future alcohol abuse in adult age [28].

Screen-based media (SBM) use has been the center of increased interest recently. It is theorized that SBM may be a potential independent factor that could have a direct impact on chronic health problems. Current recommendations suggest that children should not have any more than two hours of television viewing per day [29,30]. Research shows that young people who watch television frequently seem to be more prone to have a lower self-esteem [7], lower perceived health status [3],

poorer school grades [7], and a higher prevalence of smoking [3]. Television viewing has been associated with bullying [31], higher consumption of energy-rich foods [32] and lower consumption of fruit and vegetables [33]. Moreover SBM has been related to the presence of a higher number of somatic symptoms [34], alcohol and illicit drug use [13].

Dimensions of inequalities include age, gender and family affluence. There is a general increase in television viewing with age in just over half of countries involved in HBSC (Health Behaviour in School-Aged Children) survey. Television watching is significantly associated with family affluence in over half of countries that participate in the HBSC study [35, 36].

Clinical studies document that regular meal consumption can potentially reduce the risk of obesity and chronic disease through mechanisms involved in energy balance and metabolism [37, 38].

Breakfast is often considered the most important meal of the day and regular breakfast consumption is inversely associated with overweight and risk behaviors [39].

The consumption of fruit and vegetables is considered a good proxy for a healthy diet. Fruit and vegetables are a dietary protective factor for tobacco related cancers as well as for cardiovascular disease. Epidemiologic studies demonstrate a consistent relationship between a higher consumption of fruit and vegetables and a lower risk of cancer [40].

The main objective of this research is to analyze the extent of the relationship between PA and SBM and other positive and negative health indicators, highlighting the positive and negative patterns of interrelationship in a sample of Italian and Tuscan adolescents. It was hypothesized that there would be a positive correlation between PA and the positive health indicators and a negative correlation with the negative health indicators. For SBM opposite results were expected.

It was also expected that the trends that emerged in the national sample would be replicated in the analysis focusing on Tuscan adolescents, which would suggest the consistency of the pattern across different samples with similar demographics.

Methods

The HBSC survey is an international cross-sectional study conducted in collaboration with the World Health Organization's Regional Office for Europe. The main objective of HBSC is to increase understanding of those factors and processes that may have effects on adolescent health.

Participation was voluntary, and anonymity and confidentiality were ensured, parental permission to participate was obtained before the administration. Questionnaires were administered in classrooms by trained personnel [41].

The present study analyzed data from the nationally representative HBSC surveys conducted in Italy and in the Tuscan region. The study population consists of students aged 11-13-15 years, selected during the 2005/06 school year.

The questionnaires and all the methodology for the survey were approved by the Ethics Committee of the Italian Ministry of Education, Universities and Research. All questions used in the HBSC were considered included only after standardization and validation at the international level, to ensure the homogeneity of the instrument [41].

PHYSICAL ACTIVITY

PA is described as "any activity that raises your heart rate and that possibly leaves you out of breath". Respondents behavior were considered positive if they have met the physical activity guide line (PAGL) (at least 60 minutes of PA seven days a week) [42].

SCREEN-BASED MEDIA USE

SBM use was assessed asking the students how many hours per day they spent watching television (including DVDs), using the computer, play station or similar devices [43, 44]. A score of no more than two hours a day in front of the TV/PC was considered a positive behaviour. The SBM score was created by summing the mean number of hours per day of all screen based activities.

POSITIVE HEALTH INDICATORS

Critical aspects related to physical, psychological and social health were assessed through the development of indicators. Physical status was investigated through the body mass index (BMI), the consumption of fruit and the frequency per week of having breakfast. The perception of physical health status was considered to reflect both physical and psychological health. Social health was reflected in the quality of family and peer relationships.

BODY MASS INDEX

BMI was calculated from weight and height, using the following formula: weight (kg)/height (m²). BMI classes of the children were set using the Cole et al. method [45]. This method permits specific cut-off points for males and females at every age as recommended by the International Obesity Task Force (IOTF). The BMI was considered positive if students fell in the categories "underweight" or "normal-weight".

FRUIT CONSUMPTION

Consumption of fruit was assessed through a single question (How many times a week do you eat fruit?) with seven response options ("never", "less than once a week", "once a week", "2-4 times a week", "5-6 times a week", "once a day every day" and "more than once a day"). Behaviour was considered positive if the response was "more than once a day".

FREQUENCY OF BREAKFAST

To assess the frequency of breakfast consumption, students were asked to indicate the number of days they

have breakfast on school days. Breakfast was defined as having something more than just a glass of milk, tea or fruit juice. Response categories ranged from "never" to "all days of school" a week. Having breakfast "five times a week" or "on all school days" was considered a positive behavior.

PHYSICAL HEALTH STATUS

Respondents were asked to rate their physical health status on a four-point scale ("excellent", "good", "fair", "poor). Respondents that perceived their physical health status as "Good" or "excellent" were considered physically healthy.

QUALITY OF FAMILY RELATIONSHIPS

Students indicated on a four-point scale how easy it is to talk to their father, stepfather (or mother's partner), mother and step-mother (or father's partner) about things that bother them. The quality of family relations was considered as good when at least two of the responses given were "easily" or "very easily".

QUALITY OF PEER RELATIONS

The quality of peer relations was measured on a five-point Likert type scale Students were asked to indicate how much they agree with the phrase "Other students accept me as I am". The response options were ("strongly agree", "agree", "neither agree nor disagree", "disagree", "strongly disagree"). The quality of peer relationships was considered to be positive if they responded "strongly agree" or "agree" with the feeling of being under consideration.

NEGATIVE HEALTH INDICATORS

Negative health indicators are indicators that describe perceived health problems (health complaints) and health risk behaviors (tobacco use, alcohol use).

HEALTH COMPLAINTS

Students indicated the frequency with which they experienced each of the following seven symptoms: headache, stomachache, backache, feeling low, irritability or bad temper, feeling nervous, difficulty in falling asleep, feeling dizzy. The frequency was measured on a five-point scale ("about every day", "more than once a week", "about once a week", "about once a month", "rarely or never"). Students with at least one symptom

every day were considered as those that have health complaints.

TOBACCO USE

Cigarette smoking was assessed with a single question asking respondents how often do they currently smoke. Responses were registered on a four-point scale ("every day", "at least once a week but not every day", "less than once a week", "I do not smoke"). Behaviour was considered healthy is they responded that they do not smoke or that they smoke "less than once a week".

ALCOHOL USE

The use of alcohol was assessed through a single item asking "How often do you drink alcoholic drinks like beer or wine?", on a five-point scale (every day, every week, every month, rarely, never). Respondents that declared that they "never" drink alcohol were considered as those with a healthy lifestyle.

STATISTICAL ANALYSIS

Categorical variables were expressed as number of cases (%), continuous ones as mean (SD).

For a comparison between proportions of independent groups the chi-square and Z test were used, whereas for comparison of continuous variables between independent groups the t-test was used.

In order to verify the existence of possible risk factors, a logistic regression model was implemented including as covariates the variables under study, adjusted for age and sex.

Estimates of relative risk were provided through the use of odds ratio and confidence intervals at 95%.

Results with a $p < 0.05$ were considered statistically significant.

All analyses were repeated separately for males and females and performed through the SPSS software (version 16.0) and Stata (version 9.0).

Results

In Table I the number of respondents for Italy and Tuscany by grade and gender are presented. The differences for age and sex were minimal (Tab. I).

Italian students spending more than two hours in front of the TV/PC were significantly younger ($p < 0.00001$) than their Tuscan counterparts; however, in both sam-

Tab. I. Unweighted prevalence of students (number of cases and %) by gender and age (mean and SD).

	Grade			
	11 years old	13 years old	15 years old	Total
Italy (n-%)	1242 (31.7%)	1343 (34.3%)	1335 (34.1%)	3920
Males mean age by grade (SD-%)	11.51 (0.30)	13.49 (0.32)	15.45 (0.33)	1974 (50.36%)
Females mean age by grade (SD-%)	11.53 (0.29)	13.48 (0.31)	15.48 (0.32)	1946 (49.64%)
Tuscany (n-%)	988 (29.2%)	1218 (36.0%)	1175 (34.8%)	3381
Males mean age by grade (SD-%)	11.63 (0.40)	13.68 (0.59)	15.79 (0.59)	1664 (49.3%)
Females mean age by grade (SD-%)	11.62 (0.43)	13.62 (0.50)	15.69 (0.56)	1712 (50.7%)

Tab. II. Prevalence of Physical Activity (PA) and Screen-Based Media Use (SBM) by gender and grade.

	Meet Physical Activity Guide Line (PAGL) and Screen-Based Media Use (SBM) (> 2 hours for day)							
	11 y-old				13 y-old			
	Boys		Girls		Boys		Girls	
	PAGL*	SBM*	PAGL	SBM*	PAGL*	SBM	PAGL*	SBM
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Italy	**23.2** (19.9-26.4)	**55.3** (51.5-59.1)	**13.6** (10.9-16.3)	**66.7** (63.0-70.4)	**23.2** (20.1-26.4)	**50.9** (47.1-54.6)	**9.0** (6.8-11.1)	**51.8** (48.1-55.5)
Tuscany	**17.9** (14.5-21.3)	**61.6** (57.2-66.0)	**10.0** (7.4-12.6)	**74.0** (70.2-77.8)	**12.9** (10.2-15.6)	**50.3** (46.3-54.3)	**7.4** (5.3-9.5)	**52.5** (48.5-56.5)

*p < 0.05, Z Test

ples boys reported less SBM than girls (Italy: 50.6% vs. 58.0% respectively, p < 0.0001; Tuscany: 53.5% vs. 58.3% respectively, p < 0.0001).

There is a general reduction in meet PAGL as age increase in both samples (Tab. II). The prevalence of students that meet PAGL is significantly higher in the Italian sample than in the Tuscan one (15.2% vs. 10.9%, p < 0.05).In both samples the prevalence of students that meet PAGL is significantly higher in boys than girls (Italy: 20.5% vs. 9.8% respectively, p < 0.0001; Tuscany: 14.9% vs. 7.9% respectively, p < 0.0001).

SBM USE AND POSITIVE HEALTH INDICATORS

As expected, SBM was negatively related to PA in both samples. However, the relationships were modest, and do not suggest that these two behaviors are opposite ends of the same dimension. SBM use increase over the course of childhood. In Tuscany negative family relationships represented a risk factor for spending more than two hours a day in front of a screen for boys (OR = 2.35, p < 0.05). As shown in Table III in Italy, when males and females were considered separately, perceived health and frequency of breakfast consumption had a negative impact on SBM use representing risk factors for SBM use of > 2 hours a day, especially for girls (OR = 1.40, p < 0.05 and OR = 1.26, p < 0.05, respectively).

Considering the distribution of observed indicators related to a positive SBM score (spending < 2 hours a day in front of the screen), the results of the Italian sample are consistent with those of the Tuscan sample, however it includes two other variables as well, an improvement in the family relationship (p < 0.003), and in the physical health status for all children (p = 0.009). Tuscan students that perceived their health as good and had a higher frequency of breakfast consumption, primarily girls, showed a positive SBM behaviour, instead for boys a positive

Tab. III. Odds ratio (CI$_{95\%}$) for the observed variables, in total and by gender related to SBM (>2 hours for day).

	Italy			Tuscany		
	Boys	Girls	Total	Boys	Girls	Total
Age	1.070 (0.998-1.148)	1.049 (0.978-1.126)	1.049 (0.998-1.102)	1.070 (0.998-1.148)	1.220* (1.118-1.331)	1.158* (1.088-1.231)
Gender			0.710* (0.614-0.821)			1.024 (0.998-1.051)
BMI (cat)	0.748 (0.525-1.064)	0.913 (0.600-1.391)	0.779 (0.597-1.016)	0.748 (0.525-1.064)	1.899* (1.005-3.622)	1.295 (0.846-1.980)
Fruit consumption	0.868 (0.682-1.104)	1.095 (0.856-1.399)	0.974 (0.821-1.156)	1.350 (0.979-1.861)	1.095 (0.856-1.399)	1.178 (0.945-1.470)
Breakfast frequency	0.981 (0.791-1.217)	1.264* (1.029-1.551)	1.211 (0.997-1.470)	1.940 (0.965-1.735)	1.138 (0.876-1.478)	1.211 (0.997-1.470)
Physical health status	1.013 (0.667-1.536)	1.400* (1.019-1.922)	1.177 (0.881-1.574)	1.013 (0.667-1.536)	1.160 (0.815-1.653)	1.177 (0.881-1.574)
Family relationships	1.028 (0.826-1.279)	1.256 (0.373-1.738)	1.495 (0.923-2.421)	2.351* (1.217-4.543)	0.805 (0.373-1.738)	1.495 (0.923-2.421)
Peer relationships	0.952 (0.746-1.214)	0.838 (0.670-1.047)	0.952 (0.779-1.165)	0.952 (0.746-1.214)	0.838 (0.670-1.047)	00.952 (0.779-1.165)
Health complaints	1.169 (0.962-1.421)	1.444* (1.155-1.948)	1.268* (1.093-1.707)	1.169 (0.962-1.421)	1.500* (1.155-1.948)	1.403* (1.153-1.707)
Tobacco use	0.919 (0.653-1.293)	0.746* (0.521-0.993)	0.728* (0.538-0.986)	0.919 (0.653-1.293)	0.746 (0.521-1.067)	0.728* (0.538-0.986)
Alcohol use	1.423* (1.145-1.768)	1.340* (1.007-1.784)	1.381* (1.163-1.641)	1.381 (0.940-2.030)	1.219 (0.657-2.262)	1.226 (0.986-1.523)

*Chi square test, p < 0.05

	15 y-old				All age group				All	
	Boys		Girls		Boys		Girls			
	PAGL	SBM	PAGL	SBM	PAGL*	SBM	PAGL*	SBM	PAGL*	SBM
	% (95% CI)	% (95%CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
	14.7 (11.9-17.4)	45.5 (41.6-49.3)	6.9 (4.9-8.9)	56.1 (52.2-60.0)	20.5 (18.7-22.2)	50.6 (48.4-52.8)	9.8 (8.5-11.1)	58.0 (55.8-60.1)	15.2 (14.1-16.3)	54.2 (52.7-55.8)
	12.0 (9.3-14.6)	50.3 (46.1-54.4)	6.5 (4.5-8.5)	50.8 (46.7-54.7)	14.0 (12.3-15.7)	53.5 (51.1-55.9)	7.9 (6.6-9.1)	58.3 (55.9-60.6)	10.9 (9.8-11.9)	55.9 (54.2-57.6)

SBM behaviour was associated with good family relationships (p = 0.003) and positive fruit consumption behaviour (p = 0.03).

SBM use and negative health indicators

With regard to the negative health indicators considered, the results for SBM use were very similar. In both samples the students with less health complaints and less alcohol use spent less than two hours a day in front of the TV/PC (p < 0.0001), in Tuscany they tended also to smoke less cigarettes. In both samples respondents reporting more health complaints resulted to be more at risk for SBM use of more than two hours a day (OR = 1.26, p < 0.05), while use of tobacco resulted to be a protective factor for SBM use of more than two hours a day (OR = 0.72, p < 0.05). Only in the Italian sample alcohol use resulted to be a risk factor for SBM use of more than two hours a day (OR = 1.38, p < 0.05). The associations, in the Italian sample, between negative health indicators and SBM use were primarily due to a significant relationship in girls.

PA and positive health indicators

The pattern of results that emerged for positive and negative health behaviour indicators and their relation to PAGL showed some differences in the two samples. Although the associations were similar in both samples, it was only in the Italian sample that students met PAGL declared to have a significantly better physical health status (p < 0.005), in particular among girls, and a better quality of peer relationships (p < 0.012). Students that met PAGL had a significantly better consumption of fruit in both Italy and Tuscany (p < 0.00001), this effect seems to be slightly bigger in Italian boys compared to Tuscan boys and in Tuscan girls compared to Italian girls. As can be seen in Table IV, consuming less fruit, for both males and females, was a risk factor for not meeting the PAGL in both the Tuscan and Italian sample (Tuscany: OR = 1.65, p < 0.05; Italy: OR = 2.45, p < 0.05).

Tab. IV. Odds ratio ($CI_{95\%}$) for the observed variables, in total and by gender related to "PAGL".

	Italy			Tuscany		
	Boys	Girls	Total	Boys	Girls	Total
Age	1.131* (1.034-1.236)	1.190* (1.057-1.341)	1.144* (1.066-1.227)	1.040 (0.907-1.192)	1.069 (0.917-1.331)	1.057 (0.995-1.169)
Gender			2.344* (1.389-2.894)			1.765* (1.319-2.363)
BMI (cat)	1.338 (0.857-2.091)	0.723 (0.364-1.434)	1.114 (0.770-1.612)	0.664 (0.295-1.493)	1.567 (0.355-5.828)	0.871 (0.446-1.700)
Fruit consumption	1.569* (1.187-2.074)	1.846* (1.289-2.644)	1.653* (1.327-2.060)	2.128* (1.404-3.225)	2.878* (1.844-4.492)	2.454* (1.815-3.319)
Breakfast frequency	1.041 (0.793-1.366)	0.804 (0.571-1.127)	0.954 (0.772-1.177)	1.041 (0.793-1.366)	1.111 (0.571-1.792)	1.069 (0.772-1.479)
Physical health status	1.624 (0.883-2.989)	0.977 (0.665-1.688)	1.337 (0.782-2.286)	1.624 (0.883-2.989)	1.056 (0.665-2.043)	1.337 (0.782-2.286)
Family relationships	0.983 (0.748-1.293)	0.758 (0.519-1.108)	0.900 (0.691-1.125)	3.686 (0.868-15.65)	0.758 (0.519-1.108)	1.634 (0.691-3.864)
Peer relationships	1.204 (0.878-1.650)	1.085 (0.747-2.435)	1.222 (0.869-1.718)	1.204 (0.878-1.650)	1.085 (0.747-2.435)	1.222 (0.869-1.718)
Health complaints	0.935 (0.733-1.193)	0.912 (0.626-1.330)	0.935 (0.763-1.145)	0.571* (0.375-0.868)	0.912 (0.626-1.330)	0.694* (0.510-0.945)
Tobacco use	1.103 (0.700-1.739)	0.840 (0.449-1.552)	1.013 (0.700-1.466)	0.595 (0.297-1.195)	1.159 (0.449-1.552)	0.841 (0.509-1.389)
Alcohol use	0.869 (0.663-1.138)	0.746 (0.416-1.341)	0.959 (0.675-1.361)	1.117 (0.718-1.739)	0.746 (0.416-1.341)	0.959 (0.675-1.361)

*Chi square test, p < 0.05

Only males that met PAGL had a significantly better BMI (Italian boys p = 0.023; Tuscan boys p = 0.012).

PHYSICAL ACTIVITY AND NEGATIVE HEALTH INDICATORS

Considering the pattern of association of PA and negative health behaviour indicators, the results do not show a significant relationship between cigarette smoking and/or alcohol use and having less than 60 minutes of physical activity seven days a week. However, it is interesting to note that in the Tuscan sample, more health complaints was a protective factor for PAGL (OR = 0.694, p < 0.05), mainly for boys (Tab. IV).

In the Tuscan sample, meeting the PAGL was associated with less alcohol use (p = 0.04).

Discussion

In this analysis regular PA has been consistently associated with positive health indicators. To the contrary high SBM use was associated with worse physical health, quality of life, quality of family relationships and breakfast frequency. Even though the extent of some of these relationships was small, the fact that the results was constant considering various health behaviours and across different geographical areas lead to the conclusion that PA and SBM use may be considered as general indicators of physical, psychological and social health.

The results provide a solid base for the promotion of PA and a reduction in the use of SBM in adolescents. The potential general positive effects regular PA as part of a healthy lifestyle includes amongst others a general sense of well-being, which in turn might promote a higher quality of psychological and social functioning [6, 10]. PA has proven to also have positive effects on mood [5] and cognitive functioning [46], which lead to believe that also the personal and social spheres of life might benefit from PA. The negative indicators associated with SBM use may be related to the fact that the use of SBM promotes a more passive lifestyle. Moreover, TV viewing signifies that adolescents are not engaging in other activities such as social interactions, or focusing on personal or social issues. An active involvement with the environment rather than a passive observation thereof has been linked with a more developed sense of competency in youth [47].

The patterns of PA and SBM use have shown clear relationships with fruit consumption and breakfast frequency. These relationships were among the most significant in both samples considered. Children, who eat breakfast regularly, generally spend less than two hours a day in front of TV/PC. Breakfast omission in physically active children contrasts with their increased energy requirements and, in accordance with our study, often it is replaced by televisions programs [37], this finding can be particularly worrying given the relationship between high energy intake and TV viewing in increasing overweight.

Both in Tuscany and Italy there is a strong association between PA and fruit consumption, the results support a transfer effect where very active children are also more likely to eat more fruit. Although increased fruit intake

is an important aspect of obesity prevention, it needs to be coupled with a decreased consumption of food with a high fat and high sugar content and increased PA. More research is needed to understand the mechanisms and moderators (e.g., gender) which influence the relationship between PA and nutrition behavior.

In Italy the quality of peer relationships was positively related to PA. It has been clearly demonstrated that peer interactions are environments for PA and peer influences represent a motivating factor for PA [48]. The relationship was not significant considering SBM use, although peer interactions and use of the media are ubiquitous elements of adolescence, and it is possible that engagement with peers is a reflection of engagement in the adolescent culture [49].

When considering the negative health indicators, it emerged that time spent watching TV/PC was related to two of the three negative health indicators in an independent way in the Tuscan sample and a third (alcohol use) in the Italian sample. These results are consistent with previous studies [22]. Tobacco use is a clear exception, representing a protective factor for SBM use. This finding can be explained by arguing that higher SBM use means more time spent in front of the TV/PC, activities typically confined to a home environment where the possibility of smoking is limited.

A more complex scenario emerged when observing PA and negative health indicators. In Tuscany, but not in Italy, PA was positively related to health status, children meeting PAGL registered less health complaints. The trend appears to be opposite, as shown in other studies, where PA and sport activities is associated with physical injuries [22].

No significant relation emerged when meeting PAGL and cigarette consumption was considered in different age and gender groups. This was true for both samples. Similar studies suggest that engaging in PA in adolescence is associated with lower rates of smoking during adolescence and adulthood [3, 28].

Adherence to PAGL, perceived health status and the quality of peer relationships were found to be better in Italian youth; Tuscan youth reported slightly more SBM use, regular breakfast consumption, fewer health complaints and a higher quality of family relationships.

The overall pattern of the relationship between PA and SBM use with positive and negative health indicators was fairly consistent across the two samples considered. PA seems to influence physical health status positively in both samples but on a significantly higher level in Italian one. It is possible that there is a PA threshold that requires a minimum amount of PA for this to have an impact on the physical health status [7] or may be limited only to vigorous PA [8]. It emerged that students in Italy were more active than their Tuscan counterparts, and as such it may appear that there are more students with PA levels above the set threshold. This threshold effect might also be influenced by gender differences insinuating that there might be different threshold for males and females. In fact, 4 out of the 11 relationships tested in this study involving PA, in both Italy and Tuscany, showed a significant for males but not for females. Gender differences also emerged in SBM use. SBM use

was associated with more health complaints in female students. The results show the importance of considering gender differences when exploring the relationships between PA and SBM use. There was a negative relationship between SBM use and physical health status in both samples considered. However this relationship was more noticeable in the Tuscan sample. Given the lack of evidence available exploring the relation between SBM use and health indicators we can only speculate about the possible relations. One possible explanation would be that expectations for the level of SBM use are different in these two areas. It can be noticed that the essential pattern is the same across country and region, which means that the primary conclusions of this study are applicable to both samples. On the other hand these geographical areas share many cultural similarities, this said, such regional similarities may have been taken into account for potential differences across studies.

Conclusions

The study has various limits that need to be taken into account in the interpretation of the results. The data are cross-sectional, as such it do not indicate a causal relationship between PA and SBM use and the various other health indicators considered. In some cases the relationships between PA and SBM and the other health indicators are rather weak, even though statistically significant. An additional aspect to take into consideration is that the data collected for this survey has been self-reported by participants. Data collected through self-report may signify that some errors could be introduced attenuating the statistical relationships, this suggests that the actual relationships between the variables considered in the study might be even stronger. However, the large sample size and the rather consistent trend of results across countries indicate that these are solid effects and but studies replicating these results in other samples is needed to confirm the generalisability of these results. The current research

in the field considering the correlation of PA and SBM with other health behaviour is limited to variables like aggression and substance use. The results of this study show that in adolescents PA is positively correlated with various health, psychological and social outcomes. The analysis carried out on PA and SBM, showed that the adolescent use of SBM adversely predicted these positive and negative findings, independently of PA behaviors.

The results also suggest that interventions targeting one of either PA or SBM in order to influence the other might not be effective. Although SBM is a sedentary behaviour the results suggest that it is not to be collocated on the opposite end of the dimension of PA. As such interventions aiming specifically at SBM use and PA are suggested as this might prove to be more effective.

Research was extended to the identification of psychological and behavioral health benefits of PA and risks related to SBM use. Such research could suggest a potential mechanism for these relationships, and shed light on potential public health concerns and educational efforts to motivate adolescents to engage in more PA while discouraging excessive SBM use. Region-specific differences should be taken into consideration for future studies of these relationships and the potential causes for such differences.

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