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PHYSICAL ACTIVITY AND HEALTH

Physical Fitness, Dietary Habits and Substance Misuse: A Cross-Sectional Analysis of the Associations in 7,600 Swedish Adolescents

RESEARCH

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ABSTRACT

Introduction: Adolescence is a period of rapid physical, psychological and social changes and a time when habits are formed. This study aimed to investigate the correlation between physical fitness, alcohol consumption, tobacco consumption and dietary habits among adolescents according to the Swedish Physical power, Mental harmony and Social capacity profile (FMS profile).

Methods: Data were collected from Swedish high school students, 1st – 3rd grade (16–19 yrs), both genders, overall, 7,600 Swedish adolescents using the FMS profile, comprising physical tests and questionnaires concerning lifestyle factors (e.g. physical fitness, dietary habits, alcohol and tobacco use). Participants included in this study met the requirements of inclusion, which were having a complete set of data, e.g. had undergone all physical tests and answered all questionnaires.

Results: A total of 13% self-reported cigarette smoking, while 37% self-reported alcohol consumption. Adolescents who smoked were older (t-test = 9.09, $p < 0.001$), heavier (t-test = 4.58, $p < 0.001$) and had greater BMI (t-test = 3.96, $p < 0.001$). Adolescents who consumed alcohol were older (t-test = 8.78, $p < 0.001$), heavier (t-test = 4.03, $p < 0.001$) and taller (t-test = 3.77, $p < 0.001$). Significant differences were found for all fitness factors, with better mobility, strength and balance in adolescents who did not smoke compared to smokers (Mann Whitney Z test = 2.77, 7.13, 5.77, respectively; all $p < 0.001$). Regularity of meals and avoidance of sweets and cakes were less prevalent in adolescents who smoked (OR (95% CI): 0.63 (0.59–0.68), 0.71 (0.66–0.77), respectively).

Conclusion: Among Swedish adolescents, tobacco and alcohol use increase with age. However, physical fitness is consistently protective against tobacco consumption, and dietary habits are mostly protective against alcohol consumption. Physical fitness and low alcohol and tobacco consumption are possible health factors.

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INTRODUCTION

Adolescence is a period of rapid physical, psychological and social changes. Thus, it is important to adopt healthy lifestyle behaviours, as this is the period where habits are formed for life (Ericsson and Karlsson, 2014; Fritz, 2017; Rehm et al., 2006). However, adolescents are reported to engage in health risk behaviours that determine their current and future health (Steptoe and Wardle, 2001), and the most common health risk behaviours are insufficient physical fitness (accompanied by decreased physical fitness), tobacco and alcohol consumption, and unhealthy diet (Nunes et al., 2016).

Physical fitness is the capacity to perform physical activity and is a determinant of numerous body functions (skeletomuscular, cardiorespiratory, endocrine and neurological) involved in performing physical activity or exercise (Bangsbo et al., 2016; Caspersen et al., 1985). Physical fitness is considered to be a powerful marker of health during childhood and adolescence and determines current and future health (Fritz, 2017; Ortega et al., 2008). However, it is constantly reported that children and adolescents have decreased physical fitness (Cohen et al., 2011; Giroir and Wright, 2018; Tomkinson and Olds, 2007). This is mainly attributed to changes/decrease in physical activity levels, as it is reported that 81% of adolescents worldwide do not engage in sufficient physical activity (Guthold et al., 2020). Decreased physical activity and physical fitness most likely emerge due to various factors, including social, physiological and behavioural (Tomkinson and Olds, 2007) and are related to other health risk behaviours.

Tobacco and alcohol use (i.e. substance misuse) are considered as the most prominent health risk behaviours and are among the major health concerns in the modern world, as they are the leading causes of mortality and morbidity (Sussman et al., 2008). Regarding adolescents, a significant cause for concern is that health risk behaviours during adolescence have health consequences for later life (Rehm et al., 2006). In Sweden, adolescents are reported as often being involved in binge drinking, smoking and using snuff (moist, smokeless tobacco popular in Scandinavian countries) (Hergens et al., 2014). A study conducted on 7,757 adolescents from Sweden (13–18-years-old) displayed that 51.5% of boys and 47.5% of girls in 2nd grade secondary school reported high alcohol consumption. Also, 9.1% of boys and 15.4% of girls in 2nd grade reported everyday smoking (Åslund and Nilsson, 2013). Furthermore, one recent study showed that cigarette use was more prevalent than using snus among Swedish adolescents (Yohannes et al., 2020). Moreover, the same study reported that 66.7% of males and 77.2% of females were non-smokers, while 66.3% of males and 65.6% of females were alcohol consumers (Yohannes et al., 2020).

Alcohol consumption is associated with increased calorie intake, while tobacco is associated with skipping meals in adolescents from Nordic countries (Samuelson, 2000). Finally, smoking and alcohol consumption are related to irregular meal patterns, increased snacking, and low consumption of fruits and vegetables among Swedish adolescents (Samuelson, 2000).

Collectively, reduced physical fitness, increased tobacco and alcohol use, and poor dietary habits represent a major health concern and the possibility of developing numerous non-communicable diseases (i.e. cardiovascular diseases, diabetes mellitus and obesity) (Rehm et al., 2006). Therefore, several studies have previously investigated the associations of health behaviours. Specifically, children and adolescents with lower cardiorespiratory fitness had a higher odds ratio of drinking alcohol and getting drunk sometimes (Castro-Piñero et al., 2012). Additionally, cardiorespiratory fitness was negatively correlated with smoking in adolescents (Castro-Piñero et al., 2012). Similar findings were reported for muscular fitness, that is, muscular fitness was negatively associated with alcohol and tobacco use in adolescents (Padilla-Moledo et al., 2012). Also, higher physical activity levels and consequently having higher physical fitness showed decreased health risk behaviours in adolescents (Delisle et al., 2010). Finally, poor dietary habits have been associated with increased tobacco and alcohol consumption (Nunes et al., 2016).

Even though Sweden, compared to other European countries, has a low prevalence of risk behaviours, those behaviours are still reported to cause one-third of all deaths in Sweden (OECD, 2019); thus, there is no doubt that interrelationships should be further investigated. Irrespective of the fact that there is an evident interest in identification of the associations that may exist among different facets of a healthy lifestyle, there is a paucity of studies investigating the associations between physical fitness and health behaviours among Swedish

adolescents in depth. Specifically, unhealthy behaviour might cause lower physical fitness and still not be a consequence. In light of that, it is important to identify the causal direction, so holistic preventive strategies can be effectively implemented in the school environment. Additionally, numerous studies have shown the differences in health behaviours according to gender and age, with more prevalent substance misuse among boys and increased prevalence with advanced age (Currie et al., 2012; Moura et al., 2018).

Therefore, the main purpose of this study was to establish the associations of physical fitness and dietary habits with tobacco and alcohol use and to determine whether physical fitness and dietary habits are protective factors for substance misuse. An additional aim was to determine the prevalence of tobacco and alcohol consumption based on demographic factors (gender and age) among adolescents from Sweden. We hypothesised a higher physical fitness level and healthy dietary habits to be protective factors against tobacco and alcohol consumption.

MATERIAL AND METHODS

PARTICIPANTS

Swedish high school students, 1st – 3rd grade (16–19 yrs), both genders, overall 7,600 Swedish adolescents were included in the analyses. The data were extracted from data collected between 2004 and 2020 on more than 42,000 profiles in 60 schools all around Sweden that were part of the Physical power, Mental harmony and Social capacity (FMS) student profile assessment, which is a tool designed for adolescents between the ages of 12 and 19 years old (Yohannes et al., 2020). All participants included in this study met the requirements for inclusion, which were being a Swedish high school student, 16–19-years-old, attending a school using the FMS instrument, having a complete set of data, e.g. had undergone all the physical tests and answered all the questionnaires included in the FMS instrument.

The participants were informed about the study procedures and aims, and a parent or a legal guardian signed the informed consent before the study's initiation. The present study was conducted in accordance with the Declaration of Helsinki for research involving human participants and was approved for retrospective and prospective data by the Swedish Ethical Review Authority (Dnr 2019-05076).

VARIABLES

Anthropometrics included measured body mass and height, and calculated body mass index (BMI). Fitness tests were conducted by physical education (PE) teachers during PE sessions and followed standardised protocols.

Muscular fitness, including muscular strength and endurance, was assessed using the following tests: sitting arm lift (with 5 kg for females and 5 or 10 kg for males), wall squat maximal hold (sitting chair), and belly back test (back extensions) sit-ups. Overall strength index (strength factor) was calculated from the mean results of all four tests (1 to 5 representing very weak, and very strong, respectively) (Yohannes et al., 2020).

The flexibility tests were carried out following warm-up. Shoulder, neck, back, chest and pelvis stretches were included. Again, the average of those tests gave an overall flexibility index/score from 1 to 5 (1 = six or more exercises needed to stretch, 2 = five of the exercises needed to stretch, 3 = three or four exercises needed to stretch, 4 = two of the exercises needed to stretch and 5 = all exercises are good). All tests are described elsewhere in more detail (Yohannes et al., 2020).

Dietary habits have been subdivided into frequency of healthy eating habits, and intakes of candy, soda, crisp, cookies, etc. FMS defines regular healthy eating habits as consuming breakfast, lunch, dinner and snack every day. These meals should include sufficient amounts of carbohydrates (pasta, potatoes, rice, bread and nuts), protein (chicken, meat, fish, beans and lentils) and vitamins and minerals (fruits and vegetables). Generally, dietary habits are observed by five items: (i) I eat breakfast, lunch and dinner regularly, (ii) I have a well-balanced food intake, (iii) I eat the right amount of food based on my physical activity habits, (iv) I do not eat sweets and cakes and (v) I do not drink energy drinks. For each item, a higher score indicates better nutritional habits.

Tobacco and alcohol use were assessed by the FMS questionnaire designed for adolescents by the Swedish Institute Physical Mental Social Health (Yohannes et al., 2020). The number of cigarettes per day has been quantified, while the number of used snuffboxes per week was recorded. Alcohol consumption was assessed by questioning about the frequency of monthly alcohol consumption; "rarely" or "never drink" was also included. However, for the purpose of logistic regression calculations (please see below for details), cigarette smoking and alcohol consumption were observed on a binary scale (No (coded as 1) vs Yes (coded as 2)).

STATISTICAL ANALYSIS

Normality of the distributions was checked by Kolmogorov Smirnov test, and statistics included calculation of means and standard deviations (for normally distributed variables) and frequencies and percentages (for non-parametric data). Analyses of differences included t-test for independent sample (for parametric variables) and Mann Whitney test (for ordinal variables).

To establish the associations that may exist between physical fitness and dietary habits (predictors), with cigarette smoking and alcohol consumption (criteria), logistic regressions were applied. Two sets of logistic regression analyses were calculated. First, all predictors (general data, anthropometrics, fitness factors and factors of dietary habits) were correlated with both criteria using the crude model (without covariates). Since preliminary analyses showed a correlation between age and gender with both criteria, logistic regressions were additionally controlled for age and gender as covariates (Model 1). The Odds Ratio (OR) with 95% confidence interval (CI) is reported. The model fit was checked by the Hosmer Lemeshow test. Statistica ver. 13.5 (Tibco Inc., Palo Alto, CA, USA) was used for all calculations, with the significance level of $p < 0.05$ applied to all calculations.

RESULTS

Of the studied adolescents, 13% self-reported cigarette smoking, while 37% self-reported alcohol consumption.

DIFFERENCES BETWEEN SUBSTANCE USERS AND NON-USERS

Descriptive statistics for age and anthropometrics and t-test differences between groups based on the prevalence of substance misuse are presented in ***Table 1***. In brief, adolescents who smoke cigarettes are older (t-test = 9.09, $p < 0.001$), heavier (t-test = 4.58, $p < 0.001$) and have greater BMI (t-test = 3.96, $p < 0.001$). Meanwhile, adolescents who consume alcohol are older (t-test = 8.78, $p < 0.001$), heavier (t-test = 4.03, $p < 0.001$) and taller (t-test = 3.77, $p < 0.001$).

Table 1 Descriptive statistics for age and anthropometrics and differences between groups according to prevalence of smoking and alcohol drinking. Data are given as Means ± standard deviations, if not specified otherwise.

	CIGARETTE SMOKING			ALCOHOL CONSUMPTION		
	NO	YES	T-TEST (P)	NO	YES	T-TEST (P)
Age (years)	16.2 ± 0.8	16.5 ± 0.9	–9.1 (0.001)	16.1 ± 0.8	16.5 ± 0.9	8.8 (0.001)
Body mass (kg)	65.3 ± 13.0	67.8 ± 14.1	–4.6 (0.001)	63.6 ± 12.9	66.7 ± 13.4	4.0 (0.001)
Body height (cm)	171.4 ± 10.6	171.8 ± 11.6	–0.9 (0.33)	169.6 ± 13.9	172.0 ± 10.6	3.8 (0.001)
Body Mass Index (kg/m^2)	22.3 ± 4.8	23.2 ± 5.8	–3.9 (0.001)	22.5 ± 6.9	22.6 ± 4.6	0.6 (0.55)

Significant differences were found for all fitness factors, with better mobility, strength and balance in adolescents who do not smoke (Mann Whitney Z test = 2.77, 7.13, 5.77, respectively; all $p < 0.001$). Non-smokers had better dietary habits considering two items: regularity of meals (Mann Whitney Z test = 12.82, $p < 0.001$) and avoidance of sweets and cakes (Mann Whitney Z test = 8.32, $p < 0.001$). No significant difference was found in fitness factors between those adolescents who consumed alcohol and those who did not. Between these two groups of adolescents, however, dietary habits were significantly different, with better dietary habits in adolescents who did not consume alcohol for all items evaluating dietary habits.

PREDICTORS OF SMOKING

Logistic regression crude model identified age and female gender as significant predictors of smoking in the studied adolescents (OR (95% CI): 1.4 (1.3–1.5), 1.1 (1.01–1.21) for female gender and age, respectively). However, inclusion of age and gender in logistic regression calculations did not significantly change the associations between fitness factors and dietary habits (predictors) and smoking prevalence (criterion). In brief, larger body mass and BMI were found to be predictors of smoking (Model 1: 1.01 (1.01–1.02), 1.03 (1.01–1.04) for body mass and BMI, respectively). Further, better fitness was protective against smoking (Model 1: 0.89 (0.84–0.96), 0.91 (0.88–0.93), 0.83 (0.79–0.88) for mobility-, strength- and balance-factor, respectively). Regularity of meals and avoidance of sweets and cakes were less prevalent in adolescents who smoke (0.63 (0.59–0.68), 0.71 (0.66–0.77), respectively) (***Figure 1***).

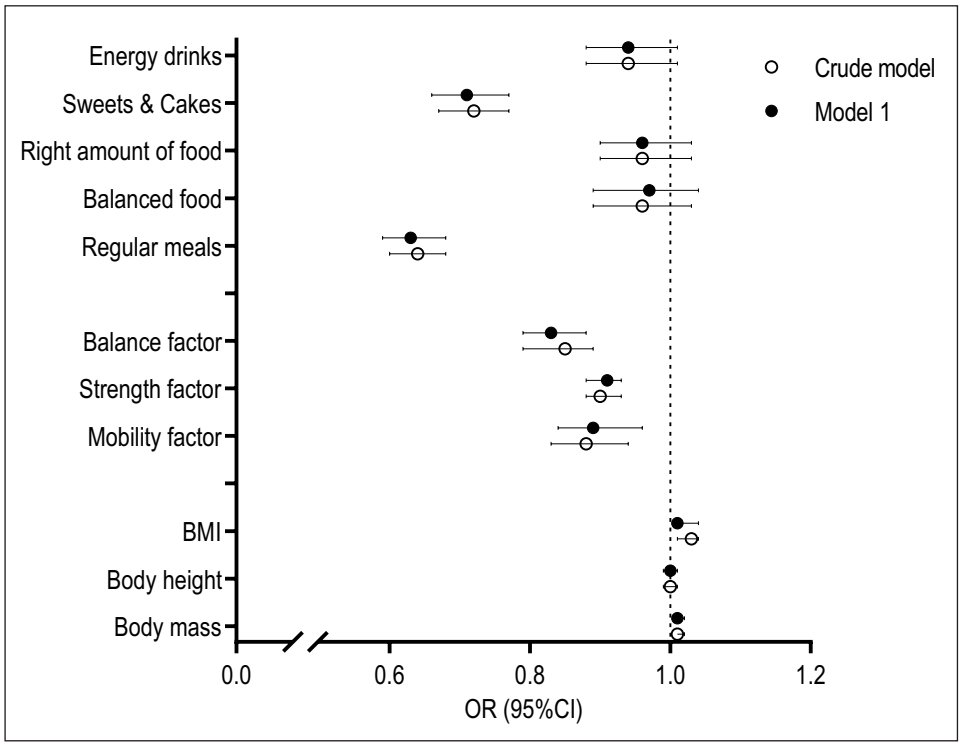

Figure 1 Logistic regression results for criterion "cigarette smoking" (Crude model: model without covariates, Model 1: age and gender are included as covariates).

○ = Crude model: model without covariates; ● = Model 1: age and gender are included as covariates; BMI = Body Mass Index.

PREDICTORS OF ALCOHOL CONSUMPTION

Age and male/female gender were correlated with alcohol consumption initially, with increased likelihood of alcohol consumption in older adolescents (1.4 (1.3–1.5)) and less prevalent alcohol consumption in females (0.82 (0.70–0.97)). Even when age and gender were included in the logistic regression calculations as covariates, results showed a higher likelihood of alcohol consumption in heavier and taller participants (Model 1: 1.02 (1.01–1.03) for both anthropometric variables). Higher likelihood of alcohol consumption was found in adolescents who achieved better results in strength factor (1.07 (1.03–1.12). Meanwhile, proper dietary habits were evidently less prevalent in adolescents who consumed alcohol. Specifically, adolescents who consumed alcohol were less likely to have regular meals (0.73 (0.65–0.82), did not report well-balanced food intake (0.41 (0.38–0.44), were less likely to report proper consumption of food amount based on their physical activity (0.45 (0.42–0.48), and evidently consumed energy drinks more often (0.44 (0.41–0.47) (***Figure 2***).

DISCUSSION

This study provides several important findings: 1) physical fitness is consistently protective against tobacco consumption, 2) dietary habits are mostly protective against alcohol consumption, while being less protective against tobacco consumption and 3) among Swedish adolescents, tobacco and alcohol use increase with age.

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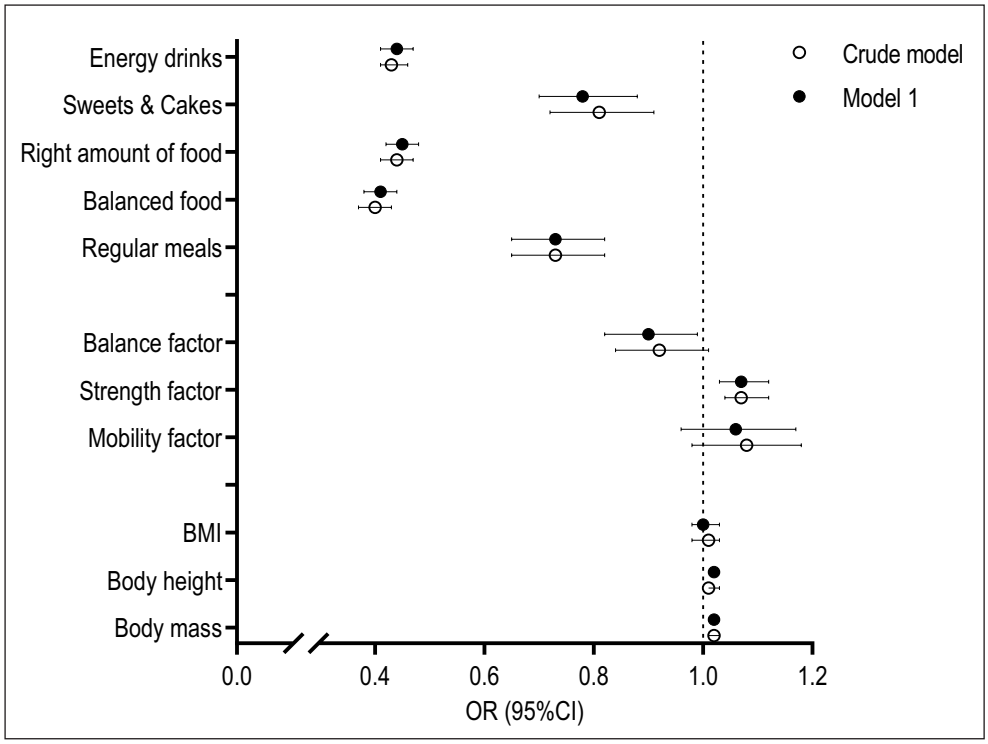

Figure 2 Logistic regression results for criterion "alcohol consumption" (Crude model: model without covariates, Model 1: age and gender are included as covariates).

○ = Crude model: model without covariates; ● = Model 1: age and gender are included as covariates; BMI = Body Mass Index.

AGE AND GENDER DIFFERENCES IN ALCOHOL AND TOBACCO CONSUMPTION

Results indicate that advancing age increases the risk of consuming alcohol, cigarettes and snuff among Swedish adolescents. In support, studies have already regularly reported a higher prevalence of risk behaviours, including substance use, with increasing age (Nunes et al., 2016). Specifically, during this period, adolescents are becoming more independent, have more choices, more responsibilities, are living in new environments (school, university, sports clubs, etc.) and are forming their adulthood identity (Moura et al., 2018). Thus, it was reported that risk behaviours commonly occur around the age of 15 and continuously rise until the age of 20, and our results directly support such considerations (Currie et al., 2012).

Our study recorded that smoking was more prevalent among boys, while drinking was more prevalent among girls. Significant gender differences in the prevalence of substance misuse are globally reported, where boys had more frequent tobacco consumption compared to girls (Currie et al., 2012). Accordingly, cigarette smoking and snus use were more frequently reported for Swedish boys compared to girls (Hedman et al., 2007). Precisely a decade ago, 16.7% of Swedish boys and 12.0% of girls aged 15 years reported smoking cigarettes, while 15.6% of boys and 4.2% of girls reported using snuff (Hedman et al., 2007). Gender differences in tobacco consumption could be found in the reasons for using tobacco (Simantov et al., 2000). Specifically, girls reported they smoke as a form of stress relief and as a method for staying slim. On the other hand, boys reported they smoke to be more accepted and popular (Simantov et al., 2000). While these issues are related to further results (associations between fitness- and dietary-factors, and substance misuse), it will be discussed in more detail later.

On a global scale, alcohol consumption is more common among boys (Currie et al., 2009). Generally, men report heavy drinking three to six times more often compared to women. This gender difference is less pronounced at a younger age, that is, girls and boys have a similar number of heavy drinking episodes (Mäkelä et al., 2006). However, results of our study indicate that girls consume alcohol more frequently than boys. Although it may seem surprising, especially taking into account global trends where alcohol consumption is much more pronounced in the male population, the higher risk for alcohol consumption in girls is not entirely a novel finding. Studies on adolescents from Brazil, Finland and Greece reported that females had a greater odds ratio for high alcohol consumption (Malta et al., 2014). It is considered that females begin drinking at younger ages since puberty begins earlier in females than in males (Malta et al., 2014). However, it is believed that this trend reverses as age increases. The most common reasons for drinking among girls are to relieve stress and forget about their problems,

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while boys reported drinking because all other popular kids drink (Simantov et al., 2000). While the period of adolescence is nowadays particularly stressful for young women (Schleider et al., 2019), the higher alcohol consumption among girls is not surprising.

PHYSICAL FITNESS AND TOBACCO AND ALCOHOL CONSUMPTION

Our results indicate that physical fitness is consistently protective against tobacco consumption (both cigarettes and snuff), which is congruent with most studies, indicating that adolescents with better physical fitness had reduced tobacco consumption (Lisha and Sussman, 2010; Wichstrøm and Wichstrøm, 2009). This could be mostly explained by awareness of the negative consequences of tobacco consumption on health status and fitness capacities. Specifically, a detrimental consequence of tobacco consumption on health status has been well documented for more than 30 years (Pederson et al., 1992). Smoking has negative effects on several components of physical fitness, including cardiorespiratory- and muscular-fitness (Conway and Cronan, 1992). Younger adults who smoked for only a few years displayed reduced muscular fitness, measured by sit-ups and push-ups, and reduced cardiorespiratory fitness, measured by an all-out aerobic test by running on a treadmill (Misigoj-Durakovic et al., 2012).

Taking into account that we observed youth who were involved in the regular school system in Sweden, it is almost certain that our participants were well informed about possible negative consequences of tobacco consumption regarding physical fitness. Naturally, such influence is particularly evident in high demanding activities (i.e. competitive sports), where even a small reduction of cardiorespiratory function is directly translated into reduced physical capacities and competitive achievement in sports. Therefore, it is expected that those adolescents who are involved in sports and are oriented towards achievement (which is unachievable without proper physical conditioning status) are taking care of their fitness status and will not consume tobacco, being aware about the potential negative effects of such behaviour on their performance.

The active population and individuals involved in sports are oriented towards success and are aware of a strong relationship between effort and success (Wichstrøm and Wichstrøm, 2009). Thus, it is logical that active individuals will not consume tobacco, as it will slow down their progress and reduce performance. In support, participation in sports and engaging in physical activity were reported as protective factors against both cigarette smoking and snus use among Swedish adolescents (Hedman et al., 2007). Authors of that study confirmed the hypothesis that individuals who are involved in sports choose a healthy lifestyle that excludes tobacco (Hedman et al., 2007). Therefore, personal health concerns are probably the most protective factors against tobacco consumption (Tyas and Pederson, 1998).

Even though one would expect that physical fitness will be a protective factor even for alcohol consumption, our results did not support such expectations, while some findings go even in the opposite direction. In brief, physical fitness was generally poorly associated with alcohol consumption; while even more – strength capacities had opposite associations with alcohol, and larger alcohol consumption was evidenced in youth who possess better strength capacities. Such findings should most probably be discussed considering the specific socio-cultural environment of competitive sports. Numerous studies have shown that adolescents involved in sports (and who at the same time possess better physical fitness) have higher alcohol consumption (Sussman et al., 2008; Wichstrøm and Wichstrøm, 2009). Therefore, the correlation between strength capacities and alcohol drinking can be explained as follows.

First, drinking alcohol is a social activity, particularly during adolescence. Second, sport is also a social activity as most sports are performed with others and expand an individual's social network (Wichstrøm and Wichstrøm, 2009). Third, alcohol is socially accepted and approved in wide social environments, often in the sports community, where the most represented form of alcohol consumption is post-exercise drinking, socialising in a café, bar or a nightclub after training or competition (Kwan et al., 2014). Not surprisingly, reports often warn about the problem of alcohol promotion in media and commercials related to sports events, which additionally encourages adolescents involved in sports to drink (Piazza-Gardner and Barry, 2012). Finally, adolescents involved in sports are advanced in strength capacities, but at the same time – consume more alcohol than their nonathletic peers, collectively resulting in a positive association between strength capacity and alcohol drinking as we have shown herein.

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The question that may arise is why the negative association between alcohol and fitness was shown solely for the facet of strength in our material? First, it is important to note that alcohol, similar to tobacco, has detrimental effects on physical performance, but those effects are less noticeable and occur more slowly than the negative consequences of tobacco (O'Brien and Lyons, 2000). This, to some extent, explains the non-significant relationship between most of the fitness variables and alcohol (i.e. youth athletes do not experience the negative effects of alcohol as much as they experience the negative effects of tobacco). Second, it is important to note that alcohol consumption is not characteristic of all sports. Indeed, studies regularly reported increased alcohol usage mostly in typical masculine sports (i.e. rugby, soccer, handball), where the largest alcohol consumption prevails. For example, it was repeatedly reported that individuals involved in American football and rugby are especially susceptible to high alcohol consumption (Eitle et al., 2003; Quarrie et al., 1996). Also, other team sports, such as soccer, handball and basketball, share similar features of training and competing, with primarily people of the same age. As a result, members of team sports have increased opportunities to drink. Hence, due to larger social networks, they can more easily obtain alcohol (O'Brien and Lyons, 2000), altogether collectively resulting in higher alcohol consumption. This is particularly true among athletes involved in sports, where strength is an important factor in competitive success.

Apart from the previously noted "slower influence of alcohol consumption on fitness status", another issue deserves attention. Specifically, the inverse U relationship between alcohol consumption and cardiorespiratory fitness that was previously noted (Baumeister et al., 2018), meaning that moderate drinkers have better cardiorespiratory fitness than non-drinkers and heavy drinkers. Similarly, moderate drinkers were reported to be three times more likely to participate in high-intensity exercise than individuals who do not drink, while heavy drinkers displayed low levels of physical fitness and low exercise intensity (Piazza-Gardner and Barry, 2012). This can be explained as individuals who are not participating in sports and are not active have fewer opportunities to socialise and drink alcohol. On the other hand, individuals who are excellent in sports or are professional athletes will not jeopardise their careers with high alcohol consumption. Individuals with moderate fitness levels are most likely participating in leisure or lower-level sports and are more exposed to social gatherings that include heavy drinking. It is reasonable to expect that a similar pattern exists, even for other fitness capacities. Altogether, it could simply statistically result in a non-significant association between most of the fitness capacities and alcohol consumption in our sample.

DIETARY HABITS AND ALCOHOL AND TOBACCO CONSUMPTION

Our results showed that dietary habits are mostly protective against alcohol consumption, while being less protective against tobacco consumption. Generally, people who take care of their health and have a healthy weight consider alcohol as a source of additional unnecessary calories (Suter, 2005). In contrast, heavy alcohol consumption is known to be associated with poor dietary habits; lower consumption of fresh fruit and vegetables; and higher intake of processed food, like canned food and sausages (La Vecchia et al., 1992). Moreover, studies often reported the clustering of lifestyle risk factors (i.e. smoking, drinking alcohol, insufficient physical fitness, overweight), meaning that those behaviours are connected, and one behaviour determines the occurrence of the other one (de Vries et al., 2008). Therefore, it is understandable that those adolescents who have better dietary habits will certainly avoid alcohol more than adolescents with poor dietary habits. Also, the opposite phenomenon could be expected, and it can be presumed that adolescents who have healthy habits, such as good dietary choices, will not take part in heavy drinking that is detrimental to their health. Altogether, it logically explains even our findings on lower alcohol consumption among adolescents with better dietary habits.

It is, at first, confusing why dietary habits are less protective against tobacco consumption compared to alcohol. This can be explained by the following assumption. One of the most important motives for proper dieting in adolescence is appearance-based, and it is most common in the period of adolescence (Vartanian et al., 2012). In other words, in their lifestyle behaviours, adolescents are often (more) concerned about the effects of their behaviour on "appearance" than on "health". With such intentions, adolescents with good dietary habits want to look nice and attractive, and their main reason for taking care of nutrition is weight control. At the same time, it is quite common that young people see smoking as a "weight

control method", mainly because nicotine suppresses appetite and reduces food intake, leading to lower body weight (Hu et al., 2018). Therefore, irrespective of the fact that tobacco consumption is a health-threatening behaviour, it can still "help" in achieving the primary goal (e.g. "being thin"), and many people consume tobacco with the goal of weight control (Hussain et al., 2012).

In support, studies confirmed that the desire to be thin and control weight was positively associated with increased cigarette smoking in adolescents, particularly among girls (Kendzor et al., 2007). Moreover, a study conducted on Swedish adolescents, aged 16–19 years, reported the association between increased snus use and unhealthy eating behaviours (Reas et al., 2019). Specifically, in both genders, meal skipping was more frequent among adolescents that use snus, while girls using snus had two to three times higher odds of skipping breakfast, lunch and dinner. Importantly, girls who used snus perceived themselves as overweight; thus, they probably used snus to decrease their weight and form better body shape (Reas et al., 2019). Even the studies in aesthetic sports confirmed such findings, where authors repeatedly reported smoking in female professionals who strive to maintain their body weight at a low level (i.e. ballet, dance) (Sekulic et al., 2010).

The self-rated questions are both a limitation and, at the same time, a strength. The participants' perception may not correlate with the actual consumption of alcohol, tobacco or food, physical fitness and sedentary behaviour.

Further research is needed to look more in depth at health promoting factors in adolescents.

CONCLUSIONS

Our results indicate that advancing age increases the risk of consuming alcohol, cigarettes and snuff among Swedish adolescents. Physical fitness is consistently protective against tobacco consumption (both cigarettes and snuff), which is in line with earlier studies. Dietary habits are mostly protective against alcohol consumption, while being less protective against tobacco consumption. Physical fitness, low alcohol and tobacco consumption are possible health promoting factors.

COMPETING INTERESTS

The authors have no competing interests to declare.

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REFERENCES

Åslund, C., & **Nilsson, K. W.** (2013). Social capital in relation to alcohol consumption, smoking, and illicit drug use among adolescents: a cross-sectional study in Sweden. *International Journal for Equity in Health, 20*, 12, 33. DOI: *https://doi.org/10.1186/1475-9276-12-33*

Bangsbo, J., Krustrup, P., Duda, J., Hillman, C., Andersen, L. B., Weiss, M., ... Elbe, A. M. (2016). The Copenhagen Consensus Conference 2016: children, youth, and physical activity in schools and duringleisure time. *British Journal of Sports Medicine, 50*(19), 1177–1178. DOI: *https://doi.org/10.1136/bjsports-2016-096325*

Baumeister, S. E., Finger, J. D., Gläser, S., Dörr, M., Markus, M. R., Ewert, R., … Leitzman, M. F. (2018). Alcohol consumption and cardiorespiratory fitness in five population-based studies. *European Journal of Preventive Cardiology, 25*(2), 164–172. DOI: *https://doi.org/10.1177/2047487317738594*

Caspersen, C. J., Powell, K. E., & **Christenson, G. M.** (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Report, 100*(2), 126–131. Retrieved from *https://pubmed.ncbi.nlm.nih.gov/3920711*

Castro-Piñero, J., Padilla-Moledo, C., Ortega, F. B., Moliner-Urdiales, D., Keating, X., & **Ruiz, J. R.** (2012). Cardiorespiratory fitness and fatness are associated with health complaints and health risk behaviors in youth. *Journal of Physical Activity and Health*, *9*(5), 642–649. DOI: *https://doi.org/10.1123/jpah.9.5.642*

Cohen, D. D., Voss, C., Taylor, M. J., Delextrat, A., Ogunleye, A. A., & **Sandercock, G. R.** (2011). Ten-year secular changes in muscular fitness in English children. *Acta Paediatrica, 100*(10), e175–177. DOI: *https://doi.org/10.1111/j.1651-2227.2011.02318.x*

Conway, T. L., & **Cronan, T. A.** (1992). Smoking, exercise, and physical fitness. *Preventive Medicine, 21*(6), 723–734. DOI: *https://doi.org/10.1016/0091-7435(92)90079-W*

Currie, C., Zanotti, C., Morgan, A., Currie, D., De Looze, M., Roberts, C., Samdal, O., Smith, O., & **Barnekow, V.** (2012). Social determinants of health and well-being among young people. Health Behaviour in School-aged Children (HBSC) study: International report from the 2009/2010 survey. Copenhagen: WHO Regional Office for Europe.

de Vries, H., van't Riet, J., Spigt, M., Metsemakers, J., van den Akker, M., Vermunt, J. K., & **Kremers, S.** (2008). Clusters of lifestyle behaviors: results from the Dutch SMILE study. *Preventive Medicine, 46*(3), 203–208. DOI: *https://doi.org/10.1016/j.ypmed.2007.08.005*

Delisle, T. T., Werch, C. E., Wong, A. H., Bian, H., & **Weiler, R.** (2010). Relationship between frequency and intensity of physical activity and health behaviors of adolescents. *Journal of School Health, 80*(3), 134–140. DOI: *https://doi.org/10.1111/j.1746-1561.2009.00477.x*

Eitle, D., Turner, R. J., & **Eitle, T. M.** (2003). The Deterrence Hypothesis Reexamined: Sports Participation and Substance Use among Young Adults. *Journal of Drug Issues, 33*(1), 193–221. DOI: *https://doi.org/10.1177/002204260303300108*

Ericsson, I., & **Karlsson, M. K.** (2014). Motor skills and school performance in children with daily physical education in school—a 9-year intervention study. *Scandinavian Journal of Medicine & Science in Sports, 24*(2), 273–278. DOI: *https://doi.org/10.1111/j.1600-0838.2012.01458.x*

Fritz, J. (2017). Physical activity during growth. Effects on bone, muscle, fracture risk and academic performance (Doctoral thesis), Lund University.

Giroir, B. P., & **Wright, D.** (2018). Physical Activity Guidelines for Health and Prosperity in the United States. *Jama, 320*(19), 1971–1972. DOI: *https://doi.org/10.1001/jama.2018.16998*

Guthold, R., Stevens, G. A., Riley, L. M., & **Bull, F. C.** (2020). Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1·6 million participants. *The Lancet & Child Adolescent Health, 4*(1), 23–35. DOI: *https://doi.org/10.1016/S2352-4642(19)30323-2*

Hedman, L., Bjerg, A., Perzanowski, M., Sundberg, S., & **Rönmark, E.** (2007). Factors related to tobacco use among teenagers. *Respiratory Medicine, 101*(3), 496–502. DOI: *https://doi.org/10.1016/j.rmed.2006.07.001*

Hergens, M.-P., Galanti, R., Hansson, J., Fredlund, P., Ahlbom, A., & **Alfredsson, L.** (2014). Use of Scandinavian Moist Smokeless Tobacco (Snus) and the Risk of Atrial Fibrillation. *Epidemiology, 25*(6), 872–876. Retrieved from *https://journals.lww.com/epidem/Fulltext/2014/11000/Use_of_Scandinavian_Moist_Smokeless_Tobacco__Snus_.13.aspx*. DOI: *https://doi.org/10.1097/EDE.0000000000000169*

Hu, T., Yang, Z., & **Li, M. D.** (2018). Pharmacological Effects and Regulatory Mechanisms of Tobacco Smoking Effects on Food Intake and Weight Control. *Journal of Neuroimmune Pharmacology, 13*(4), 453–466. DOI: *https://doi.org/10.1007/s11481-018-9800-y*

Hussain, T., Al-Daghri, N. M., Al-Attas, O. S., Draz, H. M., Abd Al-Rahman, S. H., & **Yakout, S. M.** (2012). Plasma neuropeptide Y levels relate cigarette smoking and smoking cessation to body weight regulation. *Regulatory Peptides, 176*(1–3), 22–7. DOI: *https://doi.org/10.1016/j.regpep.2012.02.005*

Kendzor, D. E., Copeland, A. L., Stewart, T. M., Businelle, M. S., & **Williamson, D. A.** (2007). Weight-related concerns associated with smoking in young children. *Addictive Behaviors, 32*(3), 598–607. DOI: *https://doi.org/10.1016/j.addbeh.2006.06.005*

Kwan, M., Bobko, S., Faulkner, G., Donnelly, P., & **Cairney, J.** (2014). Sport participation and alcohol and illicit drug use in adolescents and young adults: a systematic review of longitudinal studies. *Addictive Behaviors, 39*(3), 497–506. DOI: *https://doi.org/10.1016/j.addbeh.2013.11.006*

La Vecchia, C., Negri, E., Franceschi, S., Parazzini, F., & **Decarli, A.** (1992). Differences in dietary intake with smoking, alcohol, and education. *Nutrition and Cancer, 17*(3), 297–304. DOI: *https://doi.org/10.1080/01635589209514199*

Lisha, N. E., & **Sussman, S.** (2010). Relationship of high school and college sports participation with alcohol, tobacco, and illicit drug use: a review. *Addictive Behaviors*, *35*(5), 399–407. DOI: *https://doi.org/10.1016/j.addbeh.2009.12.032*

Mäkelä, P., Gmel, G., Grittner, U., Kuendig, H., Kuntsche, S., Bloomfield, K., & **Room, R.** (2006). Drinking pattens and their gender differences in Europe. *Alcohol and Alcoholism Supplement, 41*(1), i8–i18. DOI: *https://doi.org/10.1093/alcalc/agl071*

Malta, D. C., Mascarenhas, E. M., Porto, D. O., Barreto, S. M., & **Moraes Neto, O. L.** (2014). Exposure to alcohol among adolescent students and associated factors. [Exposição ao álcool entre escolares e fatores associados]. *Revista de Saúde Pública, 48*(1), 52–62. DOI: *https://doi.org/10.1590/S0034-8910.2014048004563*

Misigoj-Durakovic, M., Bok, D., Soric, M., Dizdar, D., Durakovic, Z., & **Jukic, I.** (2012). The effect of cigarette smoking history on muscular and cardiorespiratory endurance. *Journal of Addictive Diseases, 31*(4), 389–396. DOI: *https://doi.org/10.1080/10550887.2012.735567*

Moura, L. R., Torres, L. M., Cadete, M. M. M., & **Cunha, C. F.** (2018). Factors associated with health risk behaviors among Brazilian adolescents: an integrative review. *Revista Escola Enfermagem de USP, 52*, e03304. DOI: *https://doi.org/10.1590/s1980-220x2017020403304*

Nunes, H. E. G., Gonçalves, E. C. d. A., Vieira, J. A. J., & **Silva, D. A. S.** (2016). Clustering of Risk Factors for Non-Communicable Diseases among Adolescents from Southern Brazil. *PloS one, 11*(7), e0159037–e0159037. DOI: *https://doi.org/10.1371/journal.pone.0159037*

O'Brien, C. P., & **Lyons, F.** (2000). Alcohol and the athlete. *Sports Medicine, 29*(5), 295–300. DOI: *https://doi.org/10.2165/00007256-200029050-00001*

OECD. (2019). Sweden: Country Health Profile 2019.

Ortega, F. B., Ruiz, J. R., Castillo, M. J., & **Sjöström, M.** (2008). Physical fitness in childhood and adolescence: a powerful marker of health. *International Journal of Obesity, 32*(1), 1–11. DOI: *https://doi.org/10.1038/sj.ijo.0803774*

Padilla-Moledo, C., Ruiz, J. R., Ortega, F. B., Mora, J., & **Castro-Piñero, J.** (2012). Associations of muscular fitness with psychological positive health, health complaints, and health risk behaviors in Spanish children and adolescents. *Journal of Strength & Conditioning Research, 26*(1), 167–173. DOI: *https://doi.org/10.1519/JSC.0b013e31821c2433*

Pederson, L. L., Poulin, M., Lefcoe, N. M., Donald, A. W., & **Hill, J. S.** (1992). Does cigarette smoking affect the fitness of young adults? Rationale and protocol for future research. *Journal of Sports Medicine and Physical Fitness, 32*(1), 96–105.

Piazza-Gardner, A. K., & **Barry, A. E.** (2012). Examining physical activity levels and alcohol consumption: are people who drink more active? *American Journal of Health Promotion, 26*(3), 95–104. DOI: *https://doi.org/10.4278/ajhp.100929-LIT-328*

Quarrie, K. L., Feehan, M., Waller, A. E., Cooke, K. R., Williams, S., & **McGee, R.** (1996). The New Zealand Rugby Injury and Performance Project: alcohol use patterns within a cohort of rugby players. *Addiction.* Abingdon, England, *91*(12), 1865–1868. DOI: *https://doi.org/10.1046/j.1360-0443.1996.9112186510.x*

Reas, D. L., Wisting, L., Stedal, K., & **Dahlgren, C. L.** (2019). Unhealthy eating and weight dissatisfaction in adolescents who never, occasionally, or regularly use smokeless tobacco (Swedish snus). *International Journal of Eating Disorder, 52*(7), 846–854. DOI: *https://doi.org/10.1002/eat.23085*

Rehm, J., Taylor, B., & **Room, R.** (2006). Global burden of disease from alcohol, illicit drugs and tobacco. *Drug and Alcohol Review, 25*(6), 503–513. DOI: *https://doi.org/10.1080/09595230600944453*

Samuelson, G. (2000). Dietary habits and nutritional status in adolescents over Europe. An overview of current studies in the Nordic countries. *European Journal of Clinical Nutrition, 54*(Suppl 1), S21–28. DOI: *https://doi.org/10.1038/sj.ejcn.1600980*

Schleider, J. L., Ye, F., Wang, F., Hipwell, A. E., Chung, T., & **Sartor, C. E.** (2019). Longitudinal Reciprocal Associations Between Anxiety, Depression, and Alcohol Use in Adolescent Girls. *Alcoholism: Clinical Experimental Research, 43*(1), 98–107. DOI: *https://doi.org/10.1111/acer.13913*

Sekulic, D., Peric, M., & **Rodek, J.** (2010). Substance use and misuse among professional ballet dancers. *Substance Use & Misuse, 45*(9), 1420–1430. DOI: *https://doi.org/10.3109/10826081003682198*

Simantov, E., Schoen, C., & **Klein, J. D.** (2000). Health-compromising behaviors: why do adolescents smoke or drink?: identifying underlying risk and protective factors. *Archives Pediatrics Adolescent Medicine, 154*(10), 1025–1033. DOI: *https://doi.org/10.1001/archpedi.154.10.1025*

Steptoe, A., & **Wardle, J.** (2001). Health behaviour, risk awareness and emotional well-being in students from Eastern Europe and Western Europe. *Social Science & Medicine, 53*(12), 1621–30. DOI: *https://doi.org/10.1016/S0277-9536(00)00446-9*

Sussman, S., Skara, S., & **Ames, S. L.** (2008). Substance abuse among adolescents. *Substance Use & Misuse, 43*(12–13), 1802–1828. DOI: *https://doi.org/10.1080/10826080802297302*

Suter, P. M. (2005). Is alcohol consumption a risk factor for weight gain and obesity? *Critical Reviews in Clinical Laboratory Science*, *42*(3), 197–227. DOI: *https://doi.org/10.1080/10408360590913542*

Tomkinson, G. R., & **Olds, T. S.** (2007). Secular changes in aerobic fitness test performance of Australasian children and adolescents. *Medicine and Sport Science, 50*, 168–182. DOI: *https://doi.org/10.1159/000101361*

Tyas, S. L., & **Pederson, L. L.** (1998). Psychosocial factors related to adolescent smoking: a critical review of the literature. *Tobacco Control, 7*(4), 409–420. DOI: *https://doi.org/10.1136/tc.7.4.409*

Vartanian, L. R., Wharton, C. M., & **Green, E. B.** (2012). Appearance vs. health motives for exercise and for weight loss. *Psychology of Sport and Exercise, 13*(3), 251–256. DOI: *https://doi.org/10.1016/j.psychsport.2011.12.005*

Wichstrøm, T., & **Wichstrøm, L.** (2009). Does sports participation during adolescence prevent later alcohol, tobacco and cannabis use? *Addiction. Abingdon, England*, *104*(1), 138–149. DOI: *https://doi.org/10.1111/j.1360-0443.2008.02422.x*

Yohannes, H., Östenberg, A. H., & **Alricsson, M.** (2020). Health profile with body mass index and physical fitness in Swedish adolescents: a cross-sectional study. *International Journal of Adolescent Medicine and Health, 24*. DOI: *https://doi.org/10.1515/ijamh-2020-0169*

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