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Pathways connecting socio-economic status and health-risk behaviors

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-031737
Article Type:	Research
Date Submitted by the Author:	16-May-2019
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Keywords:	PUBLIC HEALTH, adolescents, health-risk behaviors, substance, gambling

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Manuscripts

Pathways connecting socio-economic status and health-risk behaviors

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26
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28 **Word count:** 3,059.
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DECLARATIONS

Competing interests

The authors have no competing interests to disclose.

Ethical approval and consent to participation

The study complied with the Declaration of Helsinki and with Italian Law n. 196/2003 on the protection of personal data. The questionnaires were anonymous, with no chance of individuals being identifiable. Consent to the students' participation was required first from the school director, then all parents signed to their consent to the minors' participation in the survey.

Funding

The study was sponsored and financed by the *Agenzia delle Dogane e dei Monopoli dello Stato*. The agency had no role in the design of the study, the collection, analysis, and interpretation of the data, the writing of the manuscript, or the decision to submit the paper for publication.

Data sharing

No additional data available.

Authors' contributions

Alessandra Buja conceptualized the study, interpreted the data, and drafted the manuscript.

Claudia Mortali obtained funding, coordinated all study phases, and approved the final manuscript as submitted.

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3 Luisa Mastrobattista was involved in planning and supervising the work, and approved the final
4 manuscript as submitted.
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7 Adele Minutillo was involved in planning and supervising the work, and approved the final manuscript
8 as submitted.
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11 Simona Pichini conceived, designed and directed the project.
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14 Bruno Genetti designed the data collection tools, and coordinated and supervised data collection.
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17 Paolo Vian carried out the statistical analyses, and approved the final manuscript as submitted.
18

19 Alessandra Andreotti carried out the statistical analyses, and approved the final manuscript as submitted.
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21 Giulia Grotto drafted the manuscript and approved the final manuscript as submitted.
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23 Vincenzo Baldo critically reviewed and revised the manuscript.
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25 Roberta Pacifici supervised the study, obtained funding, and approved the final manuscript as submitted.
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30 **Acknowledgements** 31

32 Not applicable.
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ABSTRACT

Background:

Pathological gambling is often associated with high comorbidity rates for alcohol-related disorders, nicotine and other substance dependence, suggesting that each of these types of behavior may serve as a primer for the others. Previous studies focused on identifying the major risk factors underlying substance use and gambling among the young, such as demographic characteristics and socio-economic status, but there is no an overall picture of their association with different health-risk behaviors. The aim of this study was to elucidate the pathway of associations linking gambling, alcohol intake, smoking habit, cannabis consumption between each other and with demographic and socio-economic variables.

Methods:

A survey was conducted in 2017 on a representative sample of 15,602 Italian 14- to 17-year-olds attending 201 secondary schools. Structural Equation Models analysis was used to assess the pathway between gambling, alcohol intake, smoking, cannabis consumption, demographics and socio-economic factors.

Results:

Irrespective of socio-economic or demographic variables, gambling is positively associated with alcohol and cannabis consumption, while cannabis consumption is predicted by smoking and by alcohol intake, smoking is predicted by alcohol intake. Adolescents with a higher weekly income are more at risk of gambling, drinking alcohol and smoking, while the degree of economic dissatisfaction was positively associated with alcohol intake, cannabis consumption and smoking. Maternal employment appeared to be positively associated with adolescents' smoking, alcohol intake and cannabis consumption.

Conclusions:

This is one of the first studies to shed light on the pathways of associations connecting various health-risk behaviors among adolescents with demographic and socioeconomic factors.

ARTICLE SUMMARY

Strengths and limitations of this study

- The study involved a representative sample of Italian school students.
- Self-reports data were collected which could be biased by under-reporting of respondents about their risk-taking behavior; to mitigate this potential bias, we guaranteed respondents' anonymity and confidentiality.
- Path analysis enables the simultaneous estimation of several associated regression showing interrelation through which independent variables produce both direct and indirect effects on more than one dependent variable; both the magnitude and the significance of associations between variables were estimated.

INTRODUCTION

In the last decade, problem gambling, alcohol consumption and substance abuse among adolescents has emerged as a growing public health issue[1,2]. Further, gambling disorder has been reclassified as an addiction and related disorder alongside alcohol and other substance use disorders[3].

Adolescence is a developmental stage in which addictions can develop when the experimental use of alcohol, tobacco and drug turns into patterns of regular substance use[4,5]. Previous studies found that pathological gambling was often associated with high comorbidity rates for alcohol-related disorders, and nicotine and substance dependence, suggesting that each of these types of behavior may serve as a primer for the others[6-9]. Other investigations suggested that acute alcohol ingestion may increase the propensity to gamble soon afterwards[10].

Just as various types of substance abuse act as a gateway to others, the literature has demonstrated that different substance abuse risk factors seem to overlap in their association with adolescents' health-risk behaviors. Specific to adolescent development, for example, is the correlation between parents' low socio-economic status (SES) and the risk of problem behavior in their adolescent offspring[11], whereas higher household incomes seem to be protective, possibly due to their linkage with positive parenting styles and advantaged life circumstances[12]. Problem gambling also seems to be more common in the low SES population[13].

Several studies have investigated the association between substance abuse or gambling risk factors - including socio-economic characteristics such as male gender, young age, neighborhood disadvantage, and low SES[14-16] - and specific types of health-risk behavior, such as alcohol drinking, cigarette smoking, and illicit substance use[15,17,18]. To our knowledge, however, no prior research has sought at the same time to examine the potential explanatory pathway between the former major risk factors and

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3 the latter health-risk behaviors. Hence, our interest in investigating how the relationships between SES
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5 and health-risk behaviors drive towards the development of gambling behavior in adolescence.
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8 In an attempt to shed light on these associations between SES, substance abuse and gambling behavior,
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10 we simultaneously considered the multiple potential pathways between gambling, alcohol intake,
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12 smoking habit, cannabis consumption, and socio-economic variables, drawing on data from a large
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14 representative population of Italian high-school students.
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METHODS

The sample population was drawn from the "Gambling in Italy" project, a student population survey conducted in 2017 by the *Istituto Superiore di Sanità*. For the purposes of the present study, the survey is briefly described below.

Study sample

The sample refers to the Italian student population between 14 and 17 years of age, taking into account the population's geographical distribution nationwide in order to intercept metropolitan, urban and suburban areas. The sampling method followed a three-stage PPS (Probability Proportional to Size) model, where the first-stage units were represented by the cities, the second-stage units by the schools, and the third-stage units by the classes. The sampling design involved stratifying the first-, second- and third-stage units as follows. In each stratum: the first-stage units (cities) were selected with probabilities proportional to the number of upper secondary school classes within the territory of the cities; the second-stage units (schools) were selected with probabilities proportional to the number of classes in the sample schools; and the third-stage units (classes) were selected in the same numbers for each school in the stratum to which they belonged. All students attending the sample classes were included in the sample. Using this sampling method meant that the probability of each class and each student in the target population being selected remained constant.

The survey was conducted using a Computer-Assisted Self Interview (CASI) method that enabled the questionnaire to be completed by students online using a non-replicable, unique, and anonymous access ID. Students accessed the questionnaire using a link provided by the technicians in the schools' computer rooms.

A total of 201 schools (187 public, 14 private) took part in the survey, and 859 classes were sampled, accounting for a student population of 18,042. A total of 17,610 online questionnaires were completed

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3 at school by the students who agreed to participate in the survey. Six questionnaires were rejected because
4 they were answered by students not resident in Italy (step 1); 267 were rejected because they were
5 incomplete (step 2); another 1,504 were rejected because they were answered by students outside the age
6 group considered in the survey (i.e. under 14 or over 17 years old) (step 3); and 231 were rejected because
7 they contained answers judged scarcely plausible (unreliable or irrelevant responses were identified by
8 means of a Rasch analysis; step 4). Thus, a final number of 15,602 questionnaires (88.6% of the total)
9 were considered eligible for this study.
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21 **Patient and public involvement, ethical approval and consent to participation**

22 The study complied with the Declaration of Helsinki and with Italian Law n. 196/2003 on the protection
23 of personal data. The questionnaires were anonymous, with no chance of individuals being identifiable.
24 Consent to the students' participation was required first from the school director, then all parents signed
25 to their consent to the minors' participation in the survey.
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32 No patients were involved in this study.
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38 **Variables**

39 The demographic variables considered were age bracket (14-15y, 16-17y), and sex.
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41 The questionnaire examined respondents' SES and social environment by means of questions on: highest
42 education level attained by parents (both with a university degree, one with a university degree, at least
43 one with a high school diploma, both with an elementary or middle-school diploma); maternal
44 employment (not working, working); paternal employment (not working, working); level of economic
45 dissatisfaction (very satisfied/satisfied, neither satisfied nor dissatisfied, dissatisfied/very dissatisfied);
46 amount of weekly pocket money (€0, €1-30, €31-100, €100 or more); parental death (both parents alive,
47 at least one parent deceased).
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3 We also categorized the geographical area (Central-Northern Italy / Southern Italy and Islands) and
4 considered the type of high school attended (vocational technical/professional schools/ scientific/artistic
5 grammar schools).
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10 The SOGS-RA scale[19,20] was used to examine respondents' gambling behavior. This validated tool
11 contains 12 items and generates scores that range from 0 to 12. It measures several aspects, such as loss
12 of control over the game, action taken to recover monetary losses, interference with family, school, and
13 relational life, guilt feelings about money spent, and consequences of gambling. To be defined as
14 "gamblers", respondents only had to report having been involved in a gambling activity at least once in
15 the previous year. Then the SOGS-RA scale identifies three types of "gambler": non-problem (SOGS-
16 RA score = 0–1); at risk (SOGS-RA = 2–3); and problem (SOGS-RA score higher than 4). Students who
17 reported having no experience of gambling in the previous year were defined as "non-gamblers". For the
18 purpose of this study, the variable assessing gambling behavior was divided into two categories: non-
19 gamblers and non-problem gamblers vs at risk and problem gamblers.
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33 Respondents were also questioned about their risk-related substance use: smoking (never in the previous
34 year / at least once in the previous year), cannabis consumption (never in the previous year / at least once
35 in the previous year) and intake of alcoholic drinks, i.e. beer, wine, cocktails, spirits (never in the previous
36 month / at least once in the previous month).
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44 **Statistical analysis**

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46 The analysis did not use a complex survey approach. Given the large sample size, Bernoulli's simple
47 random sampling method was adopted. A bivariate analysis was run on each of the above-described
48 variables and gambling status. A set of Pearson's chi-squared tests was used to highlight any associations
49 between gambling and the other variables.
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3 Path analysis via multiple regression was used to test causal models by examining the relationships
4 between a dependent variable and independent variables. This enabled the simultaneous estimation of
5 several associated regression relationships. In this analysis, a variable could be a dependent variable in
6 one relationship and an independent variable in another. This method enables both the magnitude and
7 the significance of causal connections between variables to be estimated[21], showing causal
8 mechanisms through which independent variables produce both direct and indirect effects on a dependent
9 variable.
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19 The path analysis model was estimated using Mplus® software, release 5.21[21]. To estimate the path
20 coefficients, Mplus used OLS and maximum likelihood methods. The statistics used to test the
21 significance and goodness of fit of the model were: the Root Mean Square Error of Approximation -
22 RMSEA (lower than 0.08 for a goodness of fit model), the Comparative Fit Index - CFI (higher than 0.90
23 for a goodness of fit model) and the Tucker Lewis index - TLI (higher than 0.90 for a goodness of fit
24 model)[22].
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RESULTS

Of the 15,602 questionnaires analyzed, 50.9% were answered by females, and the mean age of respondents was 15.53 years (± 1.11 SD). The prevalence of at-risk/problem gamblers was 6.5% (CI 6.1-6.9). As for the other behaviors considered, 45.4% (CI 44.6-46.2) of the students had had at least one alcoholic drink in the previous month, 25.6% (CI 24.9-26.3) had smoked at least once in the previous year, and 18.1% (CI 17.5-18.7) had consumed cannabis at least once in the previous year.

Table 1 shows the bivariate associations between the socio-demographic characteristics and the health-risk behaviors. Table 2 shows the bivariate associations between different health-risk behaviors. Figure 1 shows the pathway analysis.

Irrespective of the socio-economic and demographic variables, gambling was positively associated with alcohol and cannabis consumption, while cannabis consumption was predicted by smoking and alcohol intake, and smoking was predicted by alcohol intake. As regards the demographic factors, the pathway identified shows that males were more at risk of being involved in all the health-risk behaviors considered in this study except for smoking, while females seemed more likely to smoke. As for the socio-economic factors, adolescents with a higher weekly income were at greater risk of gambling, drinking alcohol and smoking, while the degree of economic dissatisfaction was positively associated with alcohol intake, cannabis consumption and smoking. Maternal employment seemed to be positively associated with adolescents' smoking, alcohol intake and cannabis consumption. Adolescents with better-educated parents were also at higher risk of drinking alcohol and consuming cannabis. Analyzing the geographical distribution of the different health-risk behaviors, it emerged that gambling was more common in Southern than in Central and Northern Italy, whereas cannabis consumption was more common among adolescents in the center and north of the country. When the prevalence of health-risk behavior was examined by type of school, it emerged that the vocational technical/professional school students were

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3 more at risk of gambling, smoking and consuming alcohol, whereas cannabis consumption was higher at
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5 scientific/artistic grammar schools. Lastly, respondents who reported having a deceased parent were
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7 more likely to be smokers.
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Table 1: Bivariate association between socio-economic and demographic characteristics and health-risk behaviors.

		GAMBLING			ALCOHOL INTAKE			SMOKING			CANNABIS CONSUMPTION		
		Non-gamblers + non-problem gamblers	At risk + problem gamblers	<i>p</i>	Never in previous month	At least once in previous month	<i>p</i>	Never in previous year	At least once in previous year	<i>p</i>	Never in previous year	At least once in previous year	<i>p</i>
		% (n)	% (n)		% (n)	% (n)		% (n)	% (n)		% (n)	% (n)	
Sex	Females	98.3 (7807)	1.7 (133)	<0.001	60.2 (4777)	39.8 (3163)	<0.001	72.0 (5713)	28.0 (2227)	<0.001	85.0 (6752)	15.0 (1188)	<0.001
	Males	88.5 (6783)	11.5 (879)		48.9 (3745)	51.1 (3917)		77.0 (5900)	23.0 (1762)		78.7 (6028)	21.3 (1634)	
Age bracket	14-15y	95.1 (7252)	4.9 (370)	<0.001	66.9 (5097)	33.1 (2525)	<0.001	82.8 (6314)	17.2 (1308)	<0.001	89.2 (6802)	10.8 (820)	<0.001
	16-17y	92.0 (7338)	8.0 (642)		42.9 (3425)	57.1 (4555)		66.4 (5299)	33.6 (2681)		74.9 (5978)	25.1 (2002)	
Weekly income (€)	0	97.0 (2795)	3.0 (87)	<0.001	71.3 (2054)	28.7 (828)	<0.001	87.4 (2520)	12.6 (362)	<0.001	90.5 (2608)	9.5 (274)	<0.001
	1-30	93.9 (10142)	6.1 (656)		53.3 (5752)	46.7 (5046)		73.7 (7953)	26.3 (2845)		81.7 (8819)	18.3 (1979)	
	31-100	87.9 (1406)	12.1 (193)		37.5 (600)	62.5 (999)		59.2 (946)	40.8 (653)		70.9 (1134)	29.1 (465)	
	100 or more	76.5 (247)	23.5 (76)		35.9 (116)	64.1 (207)		60.1 (194)	39.9 (129)		67.8 (219)	32.2 (104)	
Level of economic dissatisfaction	Very satisfied or satisfied	93.5 (9652)	6.5 (667)	0.003	55.8 (5758)	44.2 (4561)	<0.001	76.9 (7933)	23.1 (2386)	<0.001	84.2 (8691)	15.8 (1628)	<0.001
	Neither satisfied nor dissatisfied	93.9 (4235)	6.1 (273)		53.4 (2406)	46.6 (2102)		70.9 (3194)	29.1 (1314)		78.5 (3537)	21.5 (971)	
	Dissatisfied or very dissatisfied	90.7 (703)	9.3 (72)		46.2 (358)	53.8 (417)		62.7 (486)	37.3 (289)		71.2 (552)	28.8 (223)	
	Both have a university degree	93.9 (7147)	6.1 (468)	0.001	53.4 (4069)	46.6 (3546)	0.063	75.3 (5737)	24.7 (1878)	0.001	81.4 (6202)	18.6 (1413)	0.067
Parents' education	At least one has a university degree	92.8 (661)	7.2 (51)		56.0 (399)	44.0 (313)		74.2 (528)	25.8 (184)		80.9 (576)	19.1 (136)	
	At least one has a high school degree	93.8 (3260)	6.2 (217)		52.5 (1824)	47.5 (1653)		72.4 (2519)	27.6 (958)		80.5 (2800)	19.5 (677)	
	Both have elementary or middle school diploma	91.7 (2688)	8.3 (242)		55.4 (1623)	44.6 (1307)		72.3 (2119)	27.7 (811)		83.1 (2434)	16.9 (496)	

		GAMBLING			ALCOHOL INTAKE			SMOKING			CANNABIS CONSUMPTION		
		Non-gamblers + non- problem gamblers	At risk + problem gamblers	<i>p</i>	Never in previous month	At least once in previous month	<i>p</i>	Never in previous year	At least once in previous year	<i>p</i>	Never in previous year	At least once in previous year	<i>p</i>
		% (n)	% (n)		% (n)	% (n)		% (n)	% (n)		% (n)	% (n)	
Maternal employm	Not working	93.0 (4344)	7.0 (326)	0.095	58.4 (2728)	41.6 (1942)	<0.001	77.6 (3623)	22.4 (1047)	<0.001	85.5 (3995)	14.5 (675)	<0.001
	Working	93.7 (10046)	6.3 (671)		52.9 (5664)	47.1 (5053)		73.0 (7822)	27.0 (2895)		80.4 (8612)	19.6 (2105)	
Paternal employ	Not working	92.0 (1030)	8.0 (89)	0.042	56.9 (637)	43.1 (482)	0.081	73.1 (818)	26.9 (301)	0.221	80.6 (902)	19.4 (217)	0.188
	Working	93.6 (13093)	6.4 (894)		54.2 (7585)	45.8 (6402)		74.8 (10456)	25.2 (3531)		82.2 (11494)	17.8 (2493)	
Parental death	Both parents alive	93.6 (14325)	6.4 (986)	0.087	54.6 (8364)	45.4 (6947)	0.910	74.6 (11419)	25.4 (3892)	0.002	82.0 (12558)	18.0 (2753)	0.012
	At least one deceased parent	91.1 (265)	8.9 (26)		54.3 (158)	45.7 (133)		66.7 (194)	33.3 (97)		76.3 (222)	23.7 (69)	
Geographical area	Northern Italy	95.6 (6253)	4.4 (290)	<0.001	54.8 (3585)	45.2 (2958)	0.268	75.8 (4960)	24.2 (1583)	<0.001	81.7 (5343)	18.3 (1200)	<0.001
	Central Italy	92.7 (2709)	7.3 (214)		55.7 (1628)	44.3 (1295)		71.9 (2102)	28.1 (821)		79.1 (2312)	20.9 (611)	
	Southern Italy and Isles	91.7 (5628)	8.3 (508)		53.9 (3309)	46.1 (2827)		74.2 (4551)	25.8 (1585)		83.5 (5125)	16.5 (1011)	
Type of school	Grammar or scientific high school "licei"	95.7 (7725)	4.3 (346)	<0.001	58.0 (4682)	42.0 (3389)	<0.001	77.0 (6215)	23.0 (1856)	<0.001	83.5 (6741)	16.5 (1330)	<0.001
	Vocational technical or professional school	91.2 (6865)	8.8 (666)		51.0 (3840)	49.0 (3691)		71.7 (5398)	28.3 (2133)		80.2 (6039)	19.8 (1492)	

Table 2: Bivariate associations between different health-risk behaviors.

		ALCOHOL INTAKE			SMOKING			CANNABIS CONSUMPTION			GAMBLING		
		Never in the previous month	At least once in the previous month	<i>p</i>	Never in the previous year	At least once in the previous year	<i>p</i>	Never in the previous year	At least once in the previous year	<i>p</i>	Non-gamblers + non-problem gamblers	At risk + problem gamblers	<i>p</i>
		% (n)	% (n)		% (n)	% (n)		% (n)	% (n)		% (n)	% (n)	
ALCOHOL INTAKE	Never in the previous month				88.8 (7571)	11.2 (951)	<0.001	93.3 (7949)	6.7 (573)	<0.001	97.2 (8283)	2.8 (239)	<0.001
	At least once in the previous month				57.1 (4042)	42.9 (3038)		68.2 (4831)	31.8 (2249)		89.1 (6307)	10.9 (773)	
SMOKING	Never in the previous year							93.7 (10886)	6.3 (727)	<0.001	95.1 (11049)	4.9 (564)	<0.001
	At least once in the previous year							47.5 (1894)	52.5 (2095)		88.8 (3541)	11.2 (448)	
CANNABIS CONSUMPTION	Never in the previous year										95.3 (12174)	4.7 (606)	<0.001
	At least once in the previous year										85.6 (2416)	14.4 (406)	

DISCUSSION

The present study illustrates the pathway linking health-risk behaviors with demographic and socio-economic factors. The findings indicate that nearly one in two underage school students had had at least one alcoholic drink in the previous month, that one in four smoked, nearly one in five had consumed cannabis in the previous year, and one in fifteen could be defined as an at risk or problem gambler. These prevalence data are consistent with previous research[23]. The particular geographical distribution of the odds ratios for the prevalence of different health-risk behaviors in Italy was also in line with official records[24,25], with gambling more prevalent among students in south, and cannabis consumption more common among students in the north.

On the associations between different types of health-risk behavior, this study highlighted that gambling is associated with alcohol and cannabis consumption, even after controlling for socio-economic and demographic factors. The higher prevalence of multiple health-risk behaviors among young gamblers is a commonly recognized problem[26]. For instance, data from a U.S. sample of 2,274 young people aged 14 to 21 years showed that alcohol, tobacco and marijuana use, and conduct disorder are strong independent predictors of gambling[26]. **Error! Bookmark not defined.** This supports the concept that substance abuse and gambling behavior are part of a more general problem behavior syndrome associated with conduct disorder[26]. This concept suggests that, as one type of adolescent problem behavior increases, the likelihood of other problem behaviors developing increases too, and the co-occurrence of problem behaviors suggests that they have antecedent explanatory factors in common[26]. The tendency of some adolescents to adopt multiple health-risk behaviors could be explained by the “gateway hypothesis”[27,28], according to which an adolescent’s early experimentation with alcohol or tobacco or cannabis can escalate to more addictive illicit drug use[29].

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3 As regards the economic factors, a higher weekly income was positively associated with all the health-
4 risk behaviors considered in this study, with the exception of cannabis consumption. Consistently with
5 this finding, a New Zealand survey on a sample of secondary school students of the same age as our
6 sample (14-17 years old) revealed that the proportion of students with part-time jobs, and consequently
7 more money, was associated with a greater consumption of alcohol, cigarettes and gambling[30]. These
8 results suggest that having access to more money could increase an adolescent's chances of engaging in
9 health-risk behaviors[30]. In fact, previous research found that demand for substances is price-
10 sensitive[31,32]: following the demand model for goods and services, adolescents with higher disposable
11 incomes could also be at higher risk of substance use because they have more financial resources to
12 purchase alcohol[33], or other addictive substances[34,35]. It would be worth considering intervention
13 designed to provide young people with guidance on the use of their discretionary income[30], alongside
14 approaches that steer parents to limit the amount of money they give to their children unless they have a
15 clear picture of how it is being spent.

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17 Our study also revealed that economic dissatisfaction was associated with alcohol, smoking and cannabis
18 use, but not with gambling behavior. In line with our results, a meta-analysis[36] on marijuana and
19 alcohol use by SES in adolescents aged 10-15 years found that the prevalence of marijuana and alcohol
20 consumption was 22% higher in adolescents with a lower SES than in those with a higher SES. A possible
21 explanation for this could come from strain theory[37], according to which coming from a relatively poor
22 family (like failing at school) can be as a source of dissatisfaction that promotes potential health-risk
23 behavior, including substance use, as a way to gain respect when ordinary social valuations are
24 impossible[38]. In the light of these findings, it would be desirable for public health prevention strategies
25 to focus most on the more deprived populations in order to prevent the spread of social inequalities,
26 which might even be further aggravated by untargeted prevention schemes.

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3 As for the social context, this study found maternal employment positively associated with alcohol and
4 cannabis consumption, and smoking in adolescence. A possible explanation for this could lie in that
5 working mothers generally spend less time at home, and might monitor their children less effectively.
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7 Previous studies have shown an increased risk of tobacco and alcohol use among adolescents who
8 experience less parental supervision due to their absence from home[39]. In fact, parental monitoring,
9 which incorporates parent-youth communication, and youth supervision by parents or guardians, seems
10 to be especially influential in its association with adolescent involvement in health-risk behaviors, both
11 delaying the onset of such behaviors among naive adolescents, and containing them among adolescents
12 already practicing them[40,41].
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26 Our study highlighted a major risk of smoking in adolescents who had experienced a parent's death.
27 Other authors[42] examined the impact of exposure to family adversity (including parental death,
28 parental conflict, parental absence from home, and divorce) on the timing of smoking initiation, using
29 data from a longitudinal panel study. The four types of family adversity examined were all associated
30 with a higher risk of smoking, but losing a parent had the greatest impact on the initiation of smoking.
31 There is substantial evidence of these adverse experiences having a deleterious impact on a child's
32 developmental, behavioral, psychosocial, and physical outcomes[43]. Adolescents, in particular, may try
33 substance use in an effort to cope with their stress, as posited by stress-coping theory[44]. In parallel,
34 social learning theory suggests that people who face more adversity tend to have parents or close friends
35 who are themselves substance users[45,46], and are consequently at higher risk of substance use
36 themselves.
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53 The findings of this study emphasize the fact that health-risk behaviors are more likely in population
54 subgroups characterized by certain socio-economic variables. It would therefore be useful to design
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3 selective prevention measures (program designed for at risk groups) as well as the recommended
4 universal approaches (program designed for overall target population such as students) and indicated
5 ones (programs designed for people who are already experimenting with drugs)[47]. A good example of
6 a successfully-implemented prevention scheme is the Adolescent Transitions Program (ATP)[48]: this is
7 a school-based program that uses a tiered approach to provide prevention services for students in middle
8 school and junior high school, and their parents. A general intervention, intended for parents of all
9 students in a school, establishes a Family Resource Room to engage parents, establish norms for
10 parenting practices, and disseminate information about the risks of problem behavior and substance use
11 in adolescence. A selective intervention level, called the Family Check-Up, offers family assessments
12 and professional support to identify families at risk of problem behavior and substance use. The indicated
13 level, the Parent Focus curriculum, provides direct professional support to help parents make the changes
14 indicated by the Family Check-Up. The services may include behavioral family therapy, parenting
15 groups, or case management services[47]. The longitudinal effects of the ATP through middle school
16 and the first year of high school have been analyzed and shown that random assignments to the school-
17 based ATP were associated with a lower incidence of substance use by the first year of high school, even
18 after controlling for prior substance use in middle school[48].
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42 **Limitations**

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44 This study has a number of limitations, primarily relating to the fact that our data were obtained from a
45 sample of adolescents attending school. This means that those who dropped out of school at 16 years old
46 (on completing their compulsory education in Italy) were not considered, so our sample was only
47 representative of Italian school students. A second limitation lies in that our findings are based on self-
48 reports and may be biased by respondents' under- or over-reporting of their risk-taking behavior. To
49 mitigate this potential bias, we guaranteed respondents' anonymity and confidentiality.
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Conclusions

This is one of the first studies to analyze the explanatory pathway connecting health-risk behaviors (such as gambling, alcohol drinking, smoking and cannabis consumption) with demographic and socio-economic factors in adolescence. Clarifying the various determinants of the worrying phenomena of substance use and gambling in this age group is fundamental to the design of appropriate public health strategies and prevention measures in order to address and contain these widespread issues.

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For peer review only

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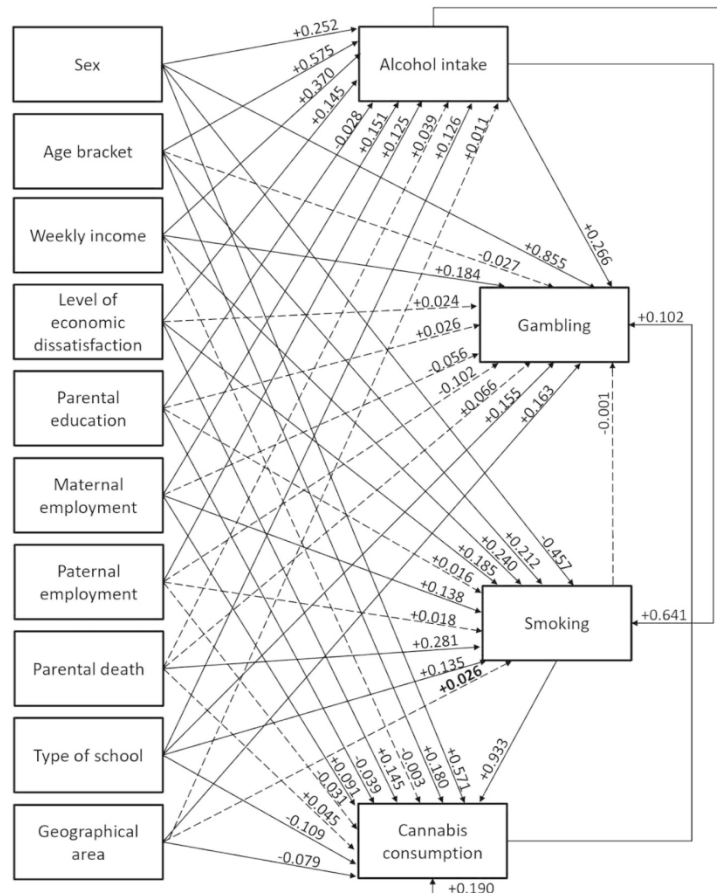


Figure 1: pathway analysis of associations between gambling, substance use, and demographic and socio-economic factors.

599x776mm (72 x 72 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	5
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	7
Objectives	3	State specific objectives, including any prespecified hypotheses	8
Methods			
Study design	4	Present key elements of study design early in the paper	9, 10, 11
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	9, 10
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	9, 10
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	10, 11
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	10, 11
Bias	9	Describe any efforts to address potential sources of bias	6, 21
Study size	10	Explain how the study size was arrived at	9, 10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10, 11
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	11, 12
		(b) Describe any methods used to examine subgroups and interactions	11, 12
		(c) Explain how missing data were addressed	/
		(d) If applicable, describe analytical methods taking account of sampling strategy	11, 12
		(e) Describe any sensitivity analyses	11, 12
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	13
		(b) Give reasons for non-participation at each stage	/
		(c) Consider use of a flow diagram	/
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	13, 14
		(b) Indicate number of participants with missing data for each variable of interest	/
Outcome data	15*	Report numbers of outcome events or summary measures	13
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13
		(b) Report category boundaries when continuous variables were categorized	13
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	/
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11, 12
Discussion			
Key results	18	Summarise key results with reference to study objectives	18, 19, 20, 21
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18, 19, 20, 21
Generalisability	21	Discuss the generalisability (external validity) of the study results	20, 21, 22
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	3

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Pathways connecting socioeconomic variables, substance abuse and gambling behavior: a cross-sectional study on a sample of Italian high-school students.

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-031737.R1
Article Type:	Original research
Date Submitted by the Author:	03-Sep-2019
Complete List of Authors:	Buja, Alessandra; University of Padua, Department of Cardiological, Thoracic, Vascular Sciences and Public Health Mortali, Claudia; Istituto Superiore di Sanità, Centro Nazionale Dipendenze e Doping Mastrobattista, Luisa; Istituto Superiore di Sanità, Centro Nazionale Dipendenze e Doping Minutillo, Adele; Istituto Superiore di Sanità, Centro Nazionale Dipendenze e Doping Pichini, Simona; Istituto Superiore di Sanità, Centro Nazionale Dipendenze e Doping Genetti, Bruno; Explora Center for Research and Statistical Analysis Vian, Paolo; Explora Center for Research and Statistical Analysis Andreotti, Alessandra; Explora Center for Research and Statistical Analysis Grotto, Giulia; University of Padua, Department of Cardiological, Thoracic, Vascular Sciences and Public Health Baldo, Vincenzo; University of Padua, Department of Cardiological, Thoracic, Vascular Sciences and Public Health Pacifci, Roberta; Istituto Superiore di Sanità, Centro Nazionale Dipendenze e Doping
Primary Subject Heading:	Public health
Secondary Subject Heading:	Paediatrics, Smoking and tobacco, Addiction
Keywords:	PUBLIC HEALTH, adolescents, health-risk behaviors, substance, gambling

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24 Alessandra Buja, Claudia Mortali, Luisa Mastrobattista, Adele Minutillo, Simona Pichini, Bruno Genetti,
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Word count: 3,186

DECLARATIONS

Competing interests

The authors have no competing interests to disclose.

Ethical approval and consent to participation

This study was approved by the ethics committee of the Italian National Health Institute. The study complied with the Declaration of Helsinki and with Italian Law n. 196/2003 on the protection of personal data. The questionnaires were anonymous, with no chance of individuals being identifiable.

Consent to the students' participation was required first from the school director, then all parents signed to their consent to the minors' participation in the survey.

Funding

The study was sponsored and financed by the *Agenzia delle Dogane e dei Monopoli dello Stato*. The agency had no role in the design of the study, the collection, analysis, and interpretation of the data, the writing of the manuscript, or the decision to submit the paper for publication.

Data sharing

The data analysis was performed on anonymized aggregate data with no chance of individuals being identifiable. Permission to use unidentifiable individual data extracted from administrative databases was granted by National Health Institute. The data are owned by National Health Institute. Requests for data can be made to the "Osservatorio Fumo, Alcol e Droga" of the National Health Institute at claudia.mortali@iss.it.

Authors' contributions

Alessandra Buja conceptualized the study, interpreted the data, and drafted the manuscript.

Claudia Mortali obtained funding, coordinated all study phases, and approved the final manuscript as submitted.

Luisa Mastrobattista was involved in planning and supervising the work, and approved the final manuscript as submitted.

Adele Minutillo was involved in planning and supervising the work, and approved the final manuscript as submitted.

Simona Pichini conceived, designed and directed the project.

Bruno Genetti designed the data collection tools, and coordinated and supervised data collection.

Paolo Vian carried out the statistical analyses, and approved the final manuscript as submitted.

Alessandra Andreotti carried out the statistical analyses, and approved the final manuscript as submitted.

Giulia Grotto drafted the manuscript and approved the final manuscript as submitted.

Vincenzo Baldo critically reviewed and revised the manuscript.

Roberta Pacifici supervised the study, obtained funding, and approved the final manuscript as submitted.

Acknowledgements

Not applicable.

ABSTRACT

Objectives:

The aim of this study was to elucidate the pathway of associations linking gambling, alcohol intake, smoking habit, cannabis consumption between each other and with demographic and socioeconomic variables.

Setting and participants:

A survey was conducted in 2017 on a representative sample of 15,602 Italian 14- to 17-year-olds attending 201 secondary schools.

Outcome measures:

Structural Equation Models analysis was used to assess the pathway between gambling, alcohol intake, smoking, cannabis consumption, demographics and socioeconomic factors.

Results:

Irrespective of socioeconomic or demographic variables, gambling is positively associated with alcohol and cannabis consumption, while cannabis consumption is predicted by smoking and by alcohol intake, smoking is predicted by alcohol intake. Adolescents with a higher weekly income are more at risk of gambling, drinking alcohol and smoking, while the degree of economic dissatisfaction was positively associated with alcohol intake, cannabis consumption and smoking. Maternal employment appeared to be positively associated with adolescents' smoking, alcohol intake and cannabis consumption.

Conclusions:

This is one of the first studies to shed light on the pathways of associations connecting various health-risk behaviors among adolescents with demographic and socioeconomic factors.

ARTICLE SUMMARY

Strengths and limitations of this study

- Data were obtained from a sample of adolescents attending school so the study sample is only representative of Italian school students. This means that adolescents who dropped out of school at 16 years old (on completing their compulsory education in Italy) were not considered.
- Self-reports data were collected which could be biased by under-reporting of respondents about their risk-taking behavior; to mitigate this potential bias, we guaranteed respondents' anonymity and confidentiality.
- Path analysis enables the simultaneous estimation of several associated regression showing interrelation through which independent variables produce both direct and indirect effects on more than one dependent variable; both the magnitude and the significance of associations between variables were estimated.

INTRODUCTION

In the last decade, problem gambling, alcohol consumption and substance abuse among adolescents has emerged as a growing public health issue[1,2]. Further, gambling disorder has been reclassified as an addiction and related disorder alongside alcohol and other substance use disorders[3].

Adolescence is a developmental stage in which addictions can develop when the experimental use of alcohol, tobacco and drug turns into patterns of regular substance use[4,5]. Previous studies found that pathological gambling was often associated with alcohol, nicotine and substance dependence, suggesting that each of these types of behavior may serve as a primer for the others[6-9]. Other investigations suggested that acute alcohol ingestion may increase the propensity to gamble soon afterwards[10].

Just as various types of substance abuse act as a gateway to others, the literature has demonstrated that different substance abuse risk factors seem to overlap in their association with adolescents' health-risk behaviors. Specific to adolescent development, for example, is the correlation between parents' low socioeconomic status (SES) and the risk of problem behavior in their adolescent offspring[11], whereas higher household incomes seem to be protective, possibly due to their linkage with positive parenting styles and advantaged life circumstances[12]. Problem gambling also seems to be more common in the low SES population[13].

Several studies have investigated the association between substance abuse or gambling risk factors - including socioeconomic characteristics such as male gender, young age, neighborhood disadvantage, and low SES[14-16] - and specific types of health-risk behavior, such as alcohol drinking, cigarette smoking, and illicit substance use[15,17,18]. To our knowledge, however, no prior research has sought at the same time to examine the potential explanatory pathway between the former major risk factors and the latter health-risk behaviors. Hence, our interest in investigating how the relationships between SES and health-risk behaviors drive towards the development of gambling behavior in adolescence.

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3 In an attempt to shed light on these associations between SES, substance abuse and gambling behavior,
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5 we simultaneously considered the multiple potential pathways between gambling, alcohol intake,
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7 smoking habit, cannabis consumption, and socioeconomic variables, drawing on data from a large
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9 representative population of Italian high-school students.
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METHODS

The sample population was drawn from the "Gambling in Italy" project, a student population survey conducted in 2017 by the *Istituto Superiore di Sanità*. For the purposes of the present study, the survey is briefly described below.

Study sample

The sample refers to the Italian student population between 14 and 17 years of age, taking into account the population's geographical distribution nationwide in order to intercept metropolitan, urban and suburban areas. The sampling method followed a three-stage PPS (Probability Proportional to Size) model, where the first-stage units were represented by the cities, the second-stage units by the schools, and the third-stage units by the classes. The sampling design involved stratifying the first-, second- and third-stage units as follows. In each stratum: the first-stage units (cities) were selected with probabilities proportional to the number of upper secondary school classes within the territory of the cities; the second-stage units (schools) were selected with probabilities proportional to the number of classes in the sample schools; and the third-stage units (classes) were selected in the same numbers for each school in the stratum to which they belonged. All students attending the sample classes were included in the sample. Using this sampling method meant that the probability of each class and each student in the target population being selected remained constant.

The survey was conducted using a Computer-Assisted Self Interview (CASI) method that enabled the questionnaire to be completed by students online using a non-replicable, unique, and anonymous access ID. Students accessed the questionnaire using a link provided by the technicians in the schools' computer rooms.

A total of 201 schools (187 public, 14 private) took part in the survey, and 859 classes were sampled, accounting for a student population of 18,042. A total of 17,610 online questionnaires were completed

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3 at school by the students who agreed to participate in the survey. Six questionnaires were rejected because
4 they were answered by students not resident in Italy (step 1); 267 were rejected because they were
5 incomplete (step 2); another 1,504 were rejected because they were answered by students outside the age
6 group considered in the survey (i.e. under 14 or over 17 years old) (step 3); and 231 were rejected because
7 they contained answers judged scarcely plausible (unreliable or irrelevant responses were identified by
8 means of a Rasch analysis; step 4). Thus, a final number of 15,602 questionnaires (88.6% of the total)
9 were considered eligible for this study.
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21 **Patient and public involvement, ethical approval and consent to participation**

22 This study was approved by the ethics committee of the Italian National Health Institute. The study
23 complied with the Declaration of Helsinki and with Italian Law n. 196/2003 on the protection of personal
24 data. The questionnaires were anonymous, with no chance of individuals being identifiable. Consent to
25 the students' participation was required first from the school director, then all parents signed to their
26 consent to the minors' participation in the survey.
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35 No patients were involved in this study.
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40 **Variables**

41 The demographic variables considered were age bracket (14-15y, 16-17y), and sex.
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44 The questionnaire examined respondents' SES and social environment by means of questions on: highest
45 education level attained by parents (both with a university degree, one with a university degree, at least
46 one with a high-school diploma, both with an elementary or middle-school diploma); maternal
47 employment (not working, working); paternal employment (not working, working); level of economic
48 dissatisfaction (very satisfied/satisfied, neither satisfied nor dissatisfied, dissatisfied/very dissatisfied);
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3 amount of weekly pocket money (€0, €1-30, €31-100, €100 or more); parental death (both parents alive,
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5 at least one parent deceased).
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7 We also categorized the geographical area (Central-Northern Italy / Southern Italy and Islands) and
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9 considered the type of high school attended (vocational technical/professional schools/ scientific/artistic
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11 grammar schools).
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14 The SOGS-RA scale[19,20] was used to examine respondents' gambling behavior. This validated tool
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16 contains 12 items and generates scores that range from 0 to 12. It measures several aspects, such as loss
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18 of control over the game, action taken to recover monetary losses, interference with family, school, and
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20 relational life, guilt feelings about money spent, and consequences of gambling. To be defined as
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22 "gamblers", respondents only had to report having been involved in a gambling activity at least once in
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24 the previous year. Then the SOGS-RA scale identifies three types of "gambler": non-problem (SOGS-
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26 RA score = 0–1); at risk (SOGS-RA = 2–3); and problem (SOGS-RA score higher than 4). Students who
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28 reported having no experience of gambling in the previous year were defined as "non-gamblers". For the
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30 purpose of this study, the variable assessing gambling behavior was divided into two categories: non-
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32 gamblers and non-problem gamblers vs at risk and problem gamblers.
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37 Respondents were also questioned about their risk-related substance use: smoking (never in the previous
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39 year / at least once in the previous year), cannabis consumption (never in the previous year / at least once
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41 in the previous year) and intake of alcoholic drinks, i.e. beer, wine, cocktails, spirits (never in the previous
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43 month / at least once in the previous month).
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49 **Statistical analysis**

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51 Previous studies found that people who gambled also tended to have problems with substance abuse[21],
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53 and that certain sociodemographic factors were shared with determinants of these health-risk behaviors.
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56 No studies currently available in the literature have considered a broader framework, however, to test for
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3 the existence of a comprehensive structure of associations. We use a path analysis to test these
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5 associations. Such an approach can be useful in planning multi-component public health care and
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7 prevention programs. Given the large sample size, Bernoulli's simple random sampling method was
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9 adopted. A bivariate analysis was run on each of the above-described variables and gambling status. A
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11 set of Pearson's chi-squared tests was used to highlight any associations between each health-risk
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13 behavior (gambling, alcohol consumption, smoking and cannabis use) and the demographic and
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15 socioeconomic variables (sex, age bracket, weekly income, level of economic dissatisfaction, paternal
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17 education, maternal employment, paternal employment, death of a parent, type of school, and
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19 geographical area).

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23 Path analysis via multiple regression was used to test causal models by examining the relationships
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25 between a dependent variable and independent variables. This enabled the simultaneous estimation of
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27 several associated regression relationships. In this analysis, a variable could be a dependent variable in
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29 one relationship and an independent variable in another. This method enables both the magnitude and
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31 the significance of causal connections between variables to be estimated[22], showing causal
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33 mechanisms through which independent variables produce both direct and indirect effects on a dependent
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35 variable.

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39 The path analysis model was estimated using Mplus® software, release 5.21[22]. To estimate the path
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41 coefficients, Mplus used OLS and maximum likelihood methods. The statistics used to test the
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43 significance and goodness of fit of the model were: the Root Mean Square Error of Approximation -
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45 RMSEA (lower than 0.08 for a goodness of fit model), the Comparative Fit Index - CFI (higher than 0.90
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47 for a goodness of fit model) and the Tucker Lewis index - TLI (higher than 0.90 for a goodness of fit
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49 model)[23].
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RESULTS

Of the 15,602 questionnaires analyzed, 50.9% were answered by females, and the mean age of respondents was 15.53 years (± 1.11 SD). The prevalence of at-risk/problem gamblers was 6.5% (CI 6.1-6.9). As for the other behaviors considered, 45.4% (CI 44.6-46.2) of the students had had at least one alcoholic drink in the previous month, 25.6% (CI 24.9-26.3) had smoked at least once in the previous year, and 18.1% (CI 17.5-18.7) had consumed cannabis at least once in the previous year.

Table 1 shows the study sample's characteristics. Table 2 shows the bivariate associations between the sociodemographic characteristics and the health-risk behaviors. Table 3 shows the bivariate associations between different health-risk behaviors. Figure 1 shows the pathway analysis.

Irrespective of the socioeconomic and demographic variables, gambling was positively associated with alcohol and cannabis consumption, while cannabis consumption was predicted by smoking and alcohol intake, and smoking was predicted by alcohol intake. As regards the demographic factors, the pathway identified shows that males were more at risk of being involved in all the health-risk behaviors considered in this study except for smoking, while females seemed more likely to smoke. As for the socioeconomic factors, adolescents with a higher weekly income were at greater risk of gambling, drinking alcohol and smoking, while the degree of economic dissatisfaction was positively associated with alcohol intake, cannabis consumption and smoking. Maternal employment seemed to be positively associated with adolescents' smoking, alcohol intake and cannabis consumption. Adolescents with better-educated parents were also at higher risk of drinking alcohol and consuming cannabis. Analyzing the geographical distribution of the different health-risk behaviors, it emerged that gambling was more common in Southern than in Central and Northern Italy, whereas cannabis consumption was more common among adolescents in the center and north of the country. When the prevalence of health-risk behavior was examined by type of school, it emerged that the vocational technical/professional school students were

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3 more at risk of gambling, smoking and consuming alcohol, whereas cannabis consumption was higher at
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5 scientific/artistic grammar schools. Lastly, respondents who reported having a deceased parent were
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7 more likely to be smokers.
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Table 1: Characteristics of the study sample

Variables	Categories	n (%)
Gender	Females	7940 (50.9%)
	Males	7662 (49.1%)
Age bracket	14-15 y	7622 (48.9%)
	16-17 y	7980 (51.1%)
Gambling	Non-gambler + non-problem gamblers	14590 (93.5%)
	At risk + problem gamblers	1012 (6.5%)
Alcohol intake	Never in the last year	8522 (54.6%)
	At least once last year	7080 (45.4%)
Smoking	Never in the last year	11613 (74.4%)
	At least once last year	3989 (25.6%)
Cannabis consumption	Never in the last year	12780 (81.9%)
	At least once last year	2822 (18.1%)
Parents' education	Both with high-school diploma or university degree	7615 (51.7%)
	At least one with university degree	712 (4.8%)
	At least one with high-school diploma	3477 (23.6%)
Mother's employment	Both with elementary or middle-school diploma	2930 (19.9%)
	Not working	4670 (30.4%)
Father's employment	Working	10717 (69.6%)
	Not working	1119 (7.4%)
Deceased parents	Working	13987 (92.6%)
	Both parents alive	15311 (98.1%)
	At least one deceased parent	291 (1.9%)
Level of economic dissatisfaction	Very satisfied or satisfied	10319 (66.1%)
	Neither satisfied nor dissatisfied	4508 (28.9%)
	Dissatisfied or very dissatisfied	775 (5%)
Weekly income (€)	0	2882 (18.5%)
	1-30	10798 (69.2%)
	31-100	1599 (10.2%)
	100 or more	323 (2.1%)
Geographical area	Northern Italy	6543 (41.9%)
	Central Italy	2923 (18.7%)
	Southern Italy and Islands	6136 (39.3%)
Type of school	Grammar school or artistic high school	8071 (51.7%)
	Technical or vocational school	7531 (48.3%)

Table 2: Bivariate association between socioeconomic and demographic characteristics and health-risk behaviors.

		GAMBLING			ALCOHOL INTAKE			SMOKING			CANNABIS CONSUMPTION		
		Non-gamblers + non-problem gamblers	At risk + problem gamblers	<i>p</i>	Never in previous year	At least once in previous year	<i>p</i>	Never in previous year	At least once in previous year	<i>p</i>	Never in previous year	At least once in previous year	<i>p</i>
		% (n)	% (n)		% (n)	% (n)		% (n)	% (n)		% (n)	% (n)	
Gen der	Females	98.3 (7807)	1.7 (133)	<0.001	60.2 (4777)	39.8 (3163)	<0.001	72.0 (5713)	28.0 (2227)	<0.001	85.0 (6752)	15.0 (1188)	<0.001
	Males	88.5 (6783)	11.5 (879)		48.9 (3745)	51.1 (3917)		77.0 (5900)	23.0 (1762)		78.7 (6028)	21.3 (1634)	
Age bracket	14-15y	95.1 (7252)	4.9 (370)	<0.001	66.9 (5097)	33.1 (2525)	<0.001	82.8 (6314)	17.2 (1308)	<0.001	89.2 (6802)	10.8 (820)	<0.001
	16-17y	92.0 (7338)	8.0 (642)		42.9 (3425)	57.1 (4555)		66.4 (5299)	33.6 (2681)		74.9 (5978)	25.1 (2002)	
Weekly income (€)	0	97.0 (2795)	3.0 (87)	<0.001	71.3 (2054)	28.7 (828)	<0.001	87.4 (2520)	12.6 (362)	<0.001	90.5 (2608)	9.5 (274)	<0.001
	1-30	93.9 (10142)	6.1 (656)		53.3 (5752)	46.7 (5046)		73.7 (7953)	26.3 (2845)		81.7 (8819)	18.3 (1979)	
	31-100	87.9 (1406)	12.1 (193)		37.5 (600)	62.5 (999)		59.2 (946)	40.8 (653)		70.9 (1134)	29.1 (465)	
	100 or more	76.5 (247)	23.5 (76)		35.9 (116)	64.1 (207)		60.1 (194)	39.9 (129)		67.8 (219)	32.2 (104)	
Level of economic dissatisfaction	Very satisfied or satisfied	93.5 (9652)	6.5 (667)	0.003	55.8 (5758)	44.2 (4561)	<0.001	76.9 (7933)	23.1 (2386)	<0.001	84.2 (8691)	15.8 (1628)	<0.001
	Neither satisfied nor dissatisfied	93.9 (4235)	6.1 (273)		53.4 (2406)	46.6 (2102)		70.9 (3194)	29.1 (1314)		78.5 (3537)	21.5 (971)	
	Dissatisfied or very dissatisfied	90.7 (703)	9.3 (72)		46.2 (358)	53.8 (417)		62.7 (486)	37.3 (289)		71.2 (552)	28.8 (223)	
	Both have a high-school diploma or university degree	93.9 (7147)	6.1 (468)	0.001	53.4 (4069)	46.6 (3546)	0.063	75.3 (5737)	24.7 (1878)	0.001	81.4 (6202)	18.6 (1413)	0.067
Parents' education	At least one has a university degree	92.8 (661)	7.2 (51)		56.0 (399)	44.0 (313)		74.2 (528)	25.8 (184)		80.9 (576)	19.1 (136)	
	At least one has a high-school diploma	93.8 (3260)	6.2 (217)		52.5 (1824)	47.5 (1653)		72.4 (2519)	27.6 (958)		80.5 (2800)	19.5 (677)	

		GAMBLING			ALCOHOL INTAKE			SMOKING			CANNABIS CONSUMPTION		
		Non-gamblers + non- problem gamblers	At risk + problem gamblers	<i>p</i>	Never in previous year	At least once in previous year	<i>p</i>	Never in previous year	At least once in previous year	<i>p</i>	Never in previous year	At least once in previous year	<i>p</i>
		% (n)	% (n)		% (n)	% (n)		% (n)	% (n)		% (n)	% (n)	
Mother's employment	Both have elementary or middle school diploma	91.7 (2688)	8.3 (242)		55.4 (1623)	44.6 (1307)		72.3 (2119)	27.7 (811)		83.1 (2434)	16.9 (496)	
	Not working	93.0 (4344)	7.0 (326)	0.095	58.4 (2728)	41.6 (1942)	<0.001	77.6 (3623)	22.4 (1047)	<0.001	85.5 (3995)	14.5 (675)	<0.001
	Working	93.7 (10046)	6.3 (671)		52.9 (5664)	47.1 (5053)		73.0 (7822)	27.0 (2895)		80.4 (8612)	19.6 (2105)	
Father's employment	Not working	92.0 (1030)	8.0 (89)	0.042	56.9 (637)	43.1 (482)	0.081	73.1 (818)	26.9 (301)	0.221	80.6 (902)	19.4 (217)	0.188
	Working	93.6 (13093)	6.4 (894)		54.2 (7585)	45.8 (6402)		74.8 (10456)	25.2 (3531)		82.2 (11494)	17.8 (2493)	
Deceased parents	Both parents alive	93.6 (14325)	6.4 (986)	0.087	54.6 (8364)	45.4 (6947)	0.910	74.6 (11419)	25.4 (3892)	0.002	82.0 (12558)	18.0 (2753)	0.012
	At least one deceased parent	91.1 (265)	8.9 (26)		54.3 (158)	45.7 (133)		66.7 (194)	33.3 (97)		76.3 (222)	23.7 (69)	
Geographical area	Northern Italy	95.6 (6253)	4.4 (290)	<0.001	54.8 (3585)	45.2 (2958)	0.268	75.8 (4960)	24.2 (1583)	<0.001	81.7 (5343)	18.3 (1200)	<0.001
	Central Italy	92.7 (2709)	7.3 (214)		55.7 (1628)	44.3 (1295)		71.9 (2102)	28.1 (821)		79.1 (2312)	20.9 (611)	
	Southern Italy and Isles	91.7 (5628)	8.3 (508)		53.9 (3309)	46.1 (2827)		74.2 (4551)	25.8 (1585)		83.5 (5125)	16.5 (1011)	
Type of school	Grammar or artistic high school	95.7 (7725)	4.3 (346)	<0.001	58.0 (4682)	42.0 (3389)	<0.001	77.0 (6215)	23.0 (1856)	<0.001	83.5 (6741)	16.5 (1330)	<0.001
	Technical or vocational school	91.2 (6865)	8.8 (666)		51.0 (3840)	49.0 (3691)		71.7 (5398)	28.3 (2133)		80.2 (6039)	19.8 (1492)	

Table 3: Bivariate associations between different health-risk behaviors.

		ALCOHOL INTAKE			SMOKING			CANNABIS CONSUMPTION			GAMBLING		
		Never in the previous year	At least once in the previous year	<i>p</i>	Never in the previous year	At least once in the previous year	<i>p</i>	Never in the previous year	At least once in the previous year	<i>p</i>	Non-gamblers + non-problem gamblers	At risk + problem gamblers	<i>p</i>
		% (n)	% (n)		% (n)	% (n)		% (n)	% (n)		% (n)	% (n)	
ALCOHOL INTAKE	Never in the previous year				88.8 (7571)	11.2 (951)	<0.001	93.3 (7949)	6.7 (573)	<0.001	97.2 (8283)	2.8 (239)	<0.001
	At least once in the previous year				57.1 (4042)	42.9 (3038)		68.2 (4831)	31.8 (2249)		89.1 (6307)	10.9 (773)	
SMOKING	Never in the previous year							93.7 (10886)	6.3 (727)	<0.001	95.1 (11049)	4.9 (564)	<0.001
	At least once in the previous year							47.5 (1894)	52.5 (2095)		88.8 (3541)	11.2 (448)	
CANNABIS CONSUMPTION	Never in the previous year										95.3 (12174)	4.7 (606)	<0.001
	At least once in the previous year										85.6 (2416)	14.4 (406)	

DISCUSSION

The present study illustrates the pathway linking health-risk behaviors with demographic and socioeconomic factors. The findings indicate that nearly one in two underage school students had had at least one alcoholic drink in the previous month, that one in four smoked, nearly one in five had consumed cannabis in the previous year, and one in fifteen could be defined as an at risk or problem gambler. These prevalence data are consistent with previous research[24]. The particular geographical distribution of the odds ratios for the prevalence of different health-risk behaviors in Italy was also in line with official records[25,26].

On the associations between different types of health-risk behavior, this study highlighted that gambling is associated with alcohol and cannabis consumption, even after controlling for socioeconomic and demographic factors. The higher prevalence of multiple health-risk behaviors among young gamblers is a commonly recognized problem[27]. For instance, data from a U.S. sample of 2,274 young people aged 14 to 21 years showed that alcohol, tobacco and marijuana use, and conduct disorder are strong independent predictors of gambling[27]. **Error! Bookmark not defined.** This supports the concept that substance abuse and gambling behavior are part of a more general problem behavior syndrome associated with conduct disorder[27]. This concept suggests that, as one type of adolescent problem behavior increases, the likelihood of other problem behaviors developing increases too, and the co-occurrence of problem behaviors suggests that they have antecedent explanatory factors in common[27]. The tendency of some adolescents to adopt multiple health-risk behaviors could be explained by the “gateway hypothesis”[28,29], according to which an adolescent’s early experimentation with alcohol or tobacco or cannabis can escalate to more addictive illicit drug use[30].

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3 As regards the economic factors, a higher weekly income was positively associated with all the health-
4 risk behaviors considered in this study, with the exception of cannabis consumption. Consistently with
5 this finding, a New Zealand survey on a sample of secondary school students of the same age as our
6 sample (14-17 years old) revealed that the proportion of students with part-time jobs, and consequently
7 more money, was associated with a greater consumption of alcohol, cigarettes and gambling[31]. These
8 results suggest that having access to more money could increase an adolescent's chances of engaging in
9 health-risk behaviors[31]. In fact, previous research found that demand for substances is price-
10 sensitive[32,33]: following the demand model for goods and services, adolescents with higher disposable
11 incomes could also be at higher risk of substance use because they have more financial resources to
12 purchase alcohol[34], or other addictive substances[35,36]. It would be worth considering intervention
13 designed to provide young people with guidance on the use of their discretionary income[31], alongside
14 approaches that steer parents to limit the amount of money they give to their children unless they have a
15 clear picture of how it is being spent.
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33 Our study also revealed that economic dissatisfaction was associated with alcohol, smoking and cannabis
34 use, but not with gambling behavior. In line with our results, a meta-analysis[37] on marijuana and
35 alcohol use by SES in adolescents aged 10-15 years found that the prevalence of marijuana and alcohol
36 consumption was 22% higher in adolescents with a lower SES than in those with a higher SES. A possible
37 explanation for this could come from strain theory[38], according to which coming from a relatively poor
38 family (like failing at school) can be as a source of dissatisfaction that promotes potential health-risk
39 behavior, including substance use, as a way to gain respect when ordinary social valuations are
40 impossible[39]. In the light of these findings, it would be desirable for public health prevention strategies
41 to focus most on the more deprived populations in order to prevent the spread of social inequalities,
42 which might even be further aggravated by untargeted prevention schemes.
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3 As for the social context, this study found maternal employment positively associated with alcohol and
4 cannabis consumption, and smoking in adolescence. A possible explanation for this could lie in that
5 working mothers generally spend less time at home, and might monitor their children less effectively.
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7 Previous studies have shown an increased risk of tobacco and alcohol use among adolescents who
8 experience less parental supervision due to their absence from home[40]. In fact, parental monitoring,
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10 which incorporates parent-youth communication, and youth supervision by parents or guardians, seems
11 to be especially influential in its association with adolescent involvement in health-risk behaviors, both
12 delaying the onset of such behaviors among naive adolescents, and containing them among adolescents
13 already practicing them[41,42].
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26 Our study highlighted a major risk of smoking in adolescents who had experienced a parent's death.
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28 Other authors[43] examined the impact of exposure to family adversity (including parental death,
29 parental conflict, parental absence from home, and divorce) on the timing of smoking initiation, using
30 data from a longitudinal panel study. The four types of family adversity examined were all associated
31 with a higher risk of smoking, but losing a parent had the greatest impact on the initiation of smoking.
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33 There is substantial evidence of these adverse experiences having a deleterious impact on a child's
34 developmental, behavioral, psychosocial, and physical outcomes[44]. Adolescents, in particular, may try
35 substance use in an effort to cope with their stress, as posited by stress-coping theory[45]. In parallel,
36 social learning theory suggests that people who face more adversity tend to have parents or close friends
37 who are themselves substance users[46,47], and are consequently at higher risk of substance use
38 themselves.
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53 The findings of this study emphasize the fact that health-risk behaviors are more likely in population
54 subgroups characterized by certain socioeconomic variables. It would therefore be useful to design
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3 selective prevention measures (program designed for at risk groups) as well as the recommended
4 universal approaches (program designed for overall target population such as students) and indicated
5 ones (programs designed for people who are already experimenting with drugs)[48]. A good example of
6 a successfully-implemented prevention scheme is the Adolescent Transitions Program (ATP)[49]: this is
7 a school-based program that uses a tiered approach to provide prevention services for students in middle
8 school and junior high school, and their parents. A general intervention, intended for parents of all
9 students in a school, establishes a Family Resource Room to engage parents, establish norms for
10 parenting practices, and disseminate information about the risks of problem behavior and substance use
11 in adolescence. A selective intervention level, called the Family Check-Up, offers family assessments
12 and professional support to identify families at risk of problem behavior and substance use. The indicated
13 level, the Parent Focus curriculum, provides direct professional support to help parents make the changes
14 indicated by the Family Check-Up. The services may include behavioral family therapy, parenting
15 groups, or case management services[48]. The longitudinal effects of the ATP through middle school
16 and the first year of high school have been analyzed and shown that random assignments to the school-
17 based ATP were associated with a lower incidence of substance use by the first year of high school, even
18 after controlling for prior substance use in middle school[49].
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42 **Limitations**

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44 This study has a couple of limitations, primarily relating to the fact that our data were obtained from a
45 sample of adolescents attending school. This means that those who dropped out of school at 16 years old
46 (on completing their compulsory education in Italy) were not considered, so our sample was only
47 representative of Italian school students. A second limitation lies in that our findings are based on self-
48 reports and may be biased by respondents' under- or over-reporting of their risk-taking behavior. To
49 mitigate this potential bias, we guaranteed respondents' anonymity and confidentiality.
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Conclusions

This is one of the first studies to analyze the explanatory pathway connecting health-risk behaviors (such as gambling, alcohol drinking, smoking and cannabis consumption) with demographic and socioeconomic factors in adolescence. Clarifying the various determinants of the worrying phenomena of substance use and gambling in this age group is fundamental to the design of appropriate public health strategies and prevention measures in order to address and contain these widespread issues.

Figure legend

Figure 1: Pathway analysis of associations between gambling, substance use, and demographic and socioeconomic factors.

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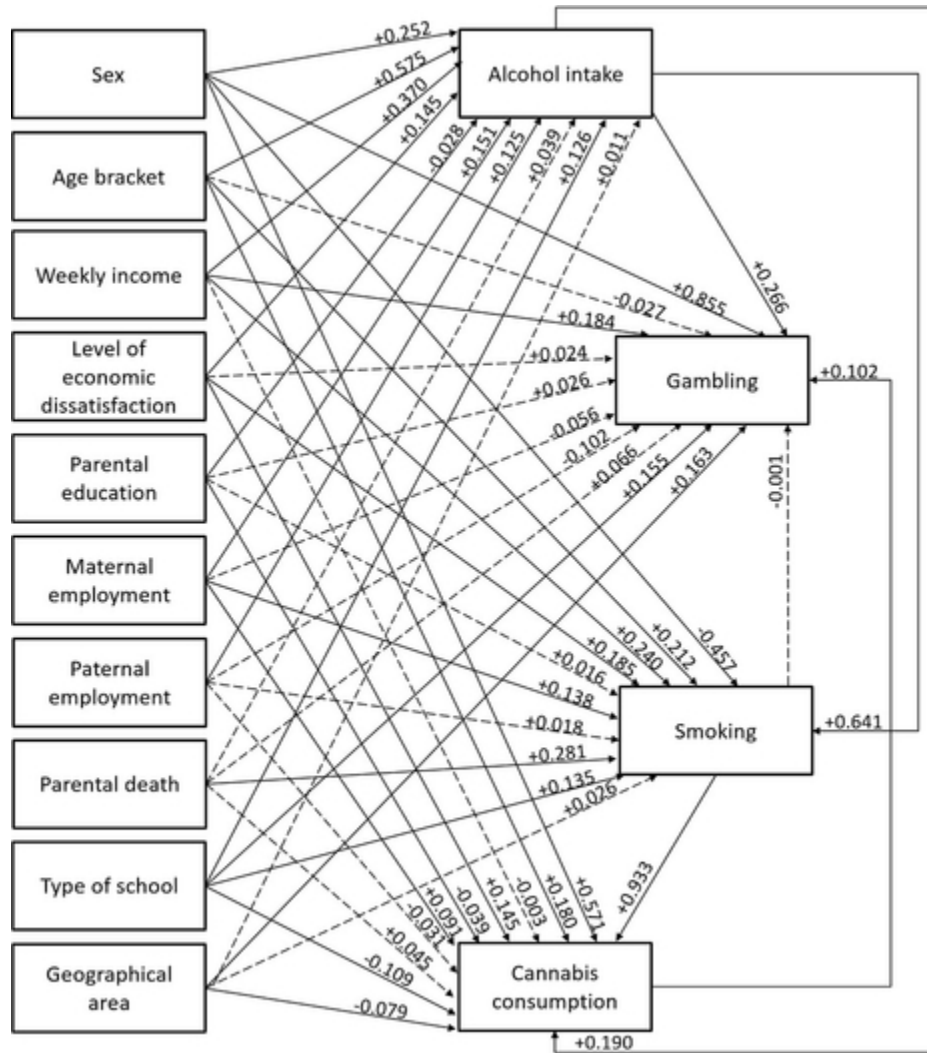


Figure 1: Pathway analysis of associations between gambling, substance use, and demographic and socioeconomic factors.

19x22mm (600 x 600 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	5
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	7
Objectives	3	State specific objectives, including any prespecified hypotheses	8
Methods			
Study design	4	Present key elements of study design early in the paper	9, 10, 11
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	9, 10
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	9, 10
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	10, 11
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	10, 11
Bias	9	Describe any efforts to address potential sources of bias	6, 21
Study size	10	Explain how the study size was arrived at	9, 10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10, 11
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	11, 12
		(b) Describe any methods used to examine subgroups and interactions	11, 12
		(c) Explain how missing data were addressed	/
		(d) If applicable, describe analytical methods taking account of sampling strategy	11, 12
		(e) Describe any sensitivity analyses	11, 12
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	13
		(b) Give reasons for non-participation at each stage	/
		(c) Consider use of a flow diagram	/
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	13, 14
		(b) Indicate number of participants with missing data for each variable of interest	/
Outcome data	15*	Report numbers of outcome events or summary measures	13
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13
		(b) Report category boundaries when continuous variables were categorized	13
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	/
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11, 12
Discussion			
Key results	18	Summarise key results with reference to study objectives	18, 19, 20, 21
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18, 19, 20, 21
Generalisability	21	Discuss the generalisability (external validity) of the study results	20, 21, 22
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	3

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.