

## Stimulant substance use and gambling behaviour in adolescents. Gambling and stimulant use

### Uso de sustancias estimulantes y comportamiento de juego en adolescentes. Juego y uso de estimulantes

ALESSANDRA BUJA\*; CLAUDIA MORTALI\*\*; LUISA MASTROBATTISTA\*\*; ELISA DE BATTISTI\*; ADELE MINUTILLO\*\*; SIMONA PICHINI\*\*; GIULIA GROTTA\*; BRUNO GENETTI\*\*\*; PAOLO VIAN\*\*\*; ALESSANDRA ANDREOTTI\*\*\*; VINCENZO BALDO\*; ROBERTA PACIFICI\*\*.

\* Departamento de ciencias cardiológicas, torácicas, vasculares y salud pública. Universidad de Padua, Padua. Italia.

\*\* Centro Nacional de Dependencia y Dopaje. Instituto Superior de Sanidad, Roma. Italia.

\*\*\* Centro Explora para investigación y análisis estadísticos, Vigodarzere (PD). Italia.

#### Abstract

Gambling is widely recognized as an important public health problem. Despite the rising use of stimulant substances among adolescents, there are still very few studies focusing on whether adolescents' use of stimulants is associated with their gambling behaviour. Therefore, the aim of this study was to investigate the association between gambling habits and consumption of stimulants such as coffee, energy drinks, and new psychoactive substances in a sample of Italian adolescents. A survey was conducted in 2017 with a representative sample of Italians between the ages of 14-17 years, comprising 15,833 students attending 201 secondary schools. Logistic regression analyses were run to assess the association between at-risk/problem gambling (O1) and independent predictors: the model included independent variables (coffee, energy drinks and new psychoactive substance consumption) and covariates (demographic variables, social environment variables and risk-taking behaviour variables). A sensitivity analysis was also conducted to examine a second dependent variable regarding any experience of gambling behaviour (O2). Adolescents who were at-risk gamblers or problem gamblers were significantly more likely to consume energy drinks than non-gamblers or not-at-risk gamblers. A similar pattern was seen for consumption of new psychoactive substances. No significant association emerged with coffee consumption. The sensitivity analysis showed that, compared with non gamblers, the group of gamblers had higher odds for frequent coffee consumption, as well as for consumption of energy drinks and/or new psychoactive substances. Screening for gambling and stimulant use may provide important information, as it may be necessary to take action to reduce stimulant substance use as part of efforts to deal with unhealthy gambling habits.

*Key Words:* Gambling; Adolescents; Substance abuse; New psychoactive substances.

#### Resumen

El juego es un importante problema de salud pública ampliamente reconocido. A pesar del creciente uso de sustancias estimulantes entre los adolescentes, todavía son escasos los estudios centrados en verificar la existencia de una asociación entre el uso de estimulantes y los comportamientos relacionados con el juego en adolescentes. Por tanto, este estudio tuvo como objetivo investigar la asociación entre los hábitos relacionados con el juego y el consumo de sustancias estimulantes como el café, las bebidas energizantes y las nuevas sustancias psicoactivas en una muestra de adolescentes italianos. En 2017 se realizó una encuesta en una muestra representativa de jóvenes italianos de 14 a 17 años, constituida por 15 833 estudiantes provenientes de 201 escuelas de educación secundaria. Se realizó un análisis de regresión logística para evaluar la asociación entre juego de riesgo/juego problemático (R1) y factores predictivos independientes: el modelo incluyó variables independientes (café, bebida energética y consumo de nuevas sustancias psicoactivas) y otras covariables demográficas, del entorno social y de conductas de riesgo. También se realizó un análisis de sensibilidad para examinar una segunda variable dependiente con respecto a cualquier experiencia de conductas relacionadas con el juego (R2). Los adolescentes clasificados como jugadores de riesgo o jugadores con problemas tenían una probabilidad significativamente mayor de consumir bebidas energizantes que los no jugadores o los jugadores sin riesgo. Se observó un patrón similar en el consumo de nuevas sustancias psicoactivas. No se evidenció ninguna asociación significativa con el consumo de café. El análisis de sensibilidad mostró que, en comparación con los no jugadores, el grupo de jugadores tenía mayores probabilidades de consumo frecuente de café, bebidas energéticas y/o nuevas sustancias psicoactivas. La evaluación del juego y el uso de sustancias estimulantes puede proporcionar información importante. Por consiguiente, podría ser necesario tomar medidas para reducir el uso de sustancias estimulantes como parte de los esfuerzos dirigidos a lidiar con los hábitos de juego poco saludables. *Palabras clave:* Juego; Adolescentes; Abuso de sustancias; Nuevas sustancias psicoactivas.

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#### Send correspondence to:

Alessandra Buja. Departamento de ciencias cardiológicas, torácicas y vasculares, Universidad de Padua. Via Loredan 18, 35127 Padoa (Italia). Tel. 049/8275387, Fax 049/8275392. E-mail: [alessandra.buja@unipd.it](mailto:alessandra.buja@unipd.it)

It is widely recognized that gambling as an important public health problem associated with substantial personal and social costs, high rates of psychiatric comorbidity, poor physical health and high suicide rates (Nautiyal, Okuda, Hen & Blanco, 2017). Early exposure to gambling in adolescence has been linked to more severe gambling-related problems later in life (Burge, Pietrzak & Petry, 2006). Large-scale prevalence studies have also confirmed high prevalence rates of gambling and problem gambling in youth. A recent review found a wide range (35,7-79,1%) of prevalence of adolescent gamblers in the past year, whereas estimated that 0.2-12.3% of adolescents worldwide exhibit problem gambling (Calado, Alexandre & Griffiths, 2017).

Surveys and reviews on gambling behavior in adolescents have consistently found that adolescent gamblers have stronger impulsive decision-making and sensation-seeking personality traits (Blinn-Pike, Worthy & Jonkman, 2010; Dowling et al., 2017; Nower, Derevensky & Gupta, 2004). There is also evidence to suggest that adolescents likely to become pathological gamblers have higher levels of state and trait anxiety (Floros, 2018). Stimulant substances increase energy levels and concentration, but they may also affect behavioral traits, increasing apprehension, anxiety, irritability, and restlessness (Ste-Marie, Gupta & Derevensky, 2006). Some, but not all studies on adolescents and young adults generally found caffeinated beverages positively associated with risk-taking, impulsivity, and sensation-seeking (Arria et al., 2011; Grant & Chamberlain, 2018; Jones & Lejuez, 2005; Kponee, Siegel & Jernigal, 2014; Temple, Ziegler, Graczyk & Crandall, 2017). In particular, Temple et al found that caffeine dose-dependently influenced decision-making and risk-taking. In other studies, caffeine did not appear to alter behavior inhibition (measured with the stop-signal task (Tieges, Snel, Kok & Richard, 2009)) or decision making (Killgore, Grugle & Balkin, 2009). Energy drinks containing caffeine together with other stimulants, such as guarana, ephedra, yohimbine, ginkgo, theophylline and L-carnitine (NFSHSASMAC, 2014), are advertised as a means to improve energy levels, athletic performance, and concentration. The market for these products and their popularity has been growing rapidly among adolescents: one study found that 31% of 12- to 17-year-olds reported regularly consuming energy drinks (Al-Shaar, Vercammen, Lu, Richardson, Tamez & Mattei, 2017; Seifert, Schaechter, Hershorin & Lipshultz, 2011). Only a few studies have reported that energy drink consumption was positively associated with gambling, in adolescent males (Gori et al., 2015), and in early adolescence too (Gallimberti et al., 2016).

In recent years, new psychoactive substances (NPS) have rapidly emerged in market of stimulants (UNODC, 2013). Although most NPS are synthetic chemicals, many of them

are plant-based substances (Feng, Battulga, Han & Chung, 2017).

Over the last decade, these substances have been introduced in the markets through various modes of distribution, including the Internet, 'smart shops' which sell drug paraphernalia, or street-level drug traffickers as legal alternatives to illicit drugs.

Estimating the prevalence of NPS use is challenging due to methodological and definitional inconsistencies, which also makes comparing national estimates difficult. A recent European study, that collected comparable data on substance use among 15- to 16-year-old students in 48 European countries found that the average of lifetime experience with NPS was 4 %, with a rate in Italy of 6% (ESPAD, 2016). The parallel effects of dopamine on gambling, and of psychostimulants across several domains (reward reinforcement, motivational priming, subjective experiential, cognitive information processing) had already been illustrated in the past (Zack & Poulos, 2009), but no study to date have analyzed the association between the consumption of such drugs and gambling.

The aim of this study was therefore to investigate the link between gambling habits and consumption of stimulant substances such as coffee, energy drinks, and new psychoactive substances in an Italian sample of adolescents.

## 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.

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

### Variables

The SOGS-RA scale (Poulin, 2002; Winters, Stinchfield & Fulkerson, 1993) was used to examine respondents' gambling behavior. This validated tool contains 12 items and scores range from 0 to 12. It measures several aspects, such as loss of control over the game, action taken to recover monetary losses, interference with family, school, and relational life, guilt feelings about money spent, and consequences of gambling. To be defined as "gamblers", respondents had to report having been involved in a gambling activity at least once in the previous year. Then the SOGS-RA scale identifies three types of gambler: non-problem (SOGS-RA score = 0–1); at-risk (SOGS-RA = 2–3); and problem (SOGS-RA score higher than 4). Students who reported having no experience of gambling in the previous year were defined as "non-gamblers".

The independent variables considered in the analysis concerned the consumption of energy drinks (ED), new psychoactive substances (NPS), or coffee (C). Each variable was classified according to respondents' self-reported usage in one of six categories: 1. "never"; 2. "only rarely, on special occasions"; 3. "some weekdays (Monday to Friday)"; 4. "only at the week-end"; 5. "some weekdays (Monday to Friday) and at the week-end"; 6. "every day of the week".

The demographic variables considered were: age, sex, nationality (Italian, EU countries, other countries). As for the respondents' social environment, they answered questions on: their family's economic level (higher, the same as, or lower than their friends' families); amount of weekly pocket money (€0-20, €21-50, €>50); social network pro-

file (yes, no); academic performance (poor, average, good or very good). The questionnaire also included questions about other risk-related substance use: smoking (never smoked, former smoker, occasional smoker, daily smoker) and alcohol drinking as beer/ wine/ cocktails/ spirits (never, occasionally but less than once a month, frequently from every month to every day).

### Statistical analysis

The analysis did not use a complex survey approach. Given the large sample size, Bernoulli's simple random sampling method was adopted. A bivariate analysis was run on each of the above-described variables and gambling status. A set of Pearson's chi squared tests was used to highlight any associations between gambling and the other variables.

Logistic regression analyses were run to assess the association between outcome (gambling status Outcome 1 (O1) = non-gamblers and not at-risk gamblers versus at-risk or problem gamblers, as defined above based on SOGS-RA scores) and predictors. The model included the independent variables (coffee, energy drinks and new psychoactive substances) in the regression as dummy variables for consumption (never, only rarely on special occasions, all other modalities) and the covariates (demographic variables, social environment variables, and risk-taking behavior variables).

A sensitivity analysis was also conducted, assessing a second dependent variable (gambling status Outcome 2 (O2) = non-gamblers versus not-at-risk, at-risk or problem gamblers, as defined above based on SOGS-RA scores), and including the same independent predictors and covariates in the subsequent model.

### Ethical issues

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

## Results

We analyzed 15,602 questionnaires. Table 1 shows the sample's characteristics.

The prevalence of non-gamblers was 70.8% (CI 95% 69.8-71.8), while 22.7% (CI 95% 21.8-23.6) of the students were reportedly not-problem gamblers, 3.5% (CI 95% 3.1-3.9) were at-risk gamblers, and 3.0% (CI 95% 2.7-3.4) were problem gamblers.

Table 2 shows the results of the bivariate analysis on gambling behavior and the different covariates. Among the at-

Table 1. Characteristics of the sample of adolescents.

	Total N = 15 602	
	N	%
<b>Sex</b>		
Male	7662	49.1
Female	7940	50.9
<b>Age</b>		
14 years old	3690	23.7
15 years old	3932	25.2
16 years old	4008	25.7
17 years old	3972	25.5
<b>Nationality</b>		
Italian	14 793	94.8
EU countries	217	1.4
Other countries	592	3.8
<b>Family's economic level</b>		
Not known	1359	8.7
Higher than friends' families	1552	9.9
Same as friends' families	11 502	73.7
Lower than friends' families	1189	7.6
<b>Pocket money weekly</b>		
€ 0-20	11 788	75.6
€ 21-50	3003	19.2
> €50	811	5.2
<b>Academic performance</b>		
Poor	403	2.6
Average	11 066	70.9
Good or very good	4133	26.5
<b>Profile on a "social network"</b>		
No	446	2.9
Yes	15 156	97.1
<b>Smoking behavior</b>		
Never smoked	8103	51.9
Former smoker	326	2.1
Occasional smoker	5356	34.3
Daily smoker	1817	11.6
<b>Alcohol drinking behavior</b>		
Never	3999	25.6
Sometimes, but less than once a month	4523	29.0
Often, from every month to every day	7080	45.4
<b>Energy drink consumption</b>		
Never	7926	50.8
Rarely	5155	33.0
Frequently	2521	16.2
<b>New psychoactive substances consumption</b>		
Never	14 952	95.8
Rarely	339	2.2
Frequently	311	2.0
<b>Coffee consumption</b>		
Never	3586	23.0
Rarely	3071	19.7
Frequently	8945	57.3

risk/problem gamblers, 86.9% were male, and 35.8% were frequent energy drink consumers (while this was true of only 14.8% of the non-gamblers and not-at-risk gamblers;  $p$ -value  $<0.001$ ). A statistically significant difference also emerged 1.5% of non-gamblers and not-at-risk gamblers as opposed to 8.5% of at-risk and problem gamblers were frequently users of new psychoactive substances;  $p$ -value  $<0.001$ . The difference between two gambler groups in frequent use of coffee was lower (56.6% vs 67.6%), but still statistically significant ( $p$ -value  $<0.001$ ).

Table 3 shows the results of the logistic regression for each outcome. Compared with non-gamblers or not-at-risk gamblers (O1), the at-risk or problem gamblers were significantly more likely to be energy drink consumers (rarely: OR 1.28, CI 95 % 1.08-1.52; frequently: OR 1.95, CI 95 % 1.62-2.34). Similar patterns emerged between the two groups for new psychoactive substances consumption (rarely: OR 1.37, CI 95 % 0.99-1.89; frequently: OR: 2.96, CI 95 % 2.21-3.95). No significant association emerged for coffee consumption.

The sensitivity analysis showed that, compared with the group of non-gambler, the group of gamblers (O2) was also positively associated with frequent coffee consumption (OR 1.20, CI 95 % 1.09-1.33), as well as rarely and frequent energy drink consumption (OR 1.44, CI 95 % 1.32-1.58 and OR 1.75, CI 95 % 1.57-1.95), and frequent new psychoactive substances consumption (OR 2.02, CI 95 % 1.58-2.60).

## Discussion

Our study demonstrates that adolescents with experience of at-risk and problem gambling have a higher likelihood of being consumers of energy drinks and new psychoactive substances, after adjusting for socio-demographic factors and consumption of other substances (smoking and alcohol drinking). Frequent coffee consumption is also associated with any experience of gambling in adolescents.

Our data show that almost one third of adolescents are engaged in gambling. Despite legal age restrictions, children and adolescents can easily access various forms of lawful gambling opportunities, and many of them do so (Malgorzata Carran, 2013). These findings warrant attention because studies on adult populations have shown that adult pathological gamblers often began their gambling careers at a relatively young age, and that the earlier people engage in gambling, the more likely they are to become problem gamblers (Burge et al., 2006).

We found coffee consumption is associated with any gambling experience in adolescents. Similarly, a study on university college students (Temple et al., 2017) pointed to a particularly strong relationship between caffeine intake, earlier age of first gambling experiences and certain types of impulsivity in gamblers. In another study on young adults, there was a significant positive correlation between

Table 2. *Bivariate analysis.*

	<b>Non-gambler / Not-at-risk gambler (N = 14,590)</b>	<b>At-risk gambler / Problem gambler (N = 1,012)</b>	<b>p-value</b>
<b>Sex</b>			
Male	46.5% (6783)	86.9% (879)	< .001
Female	53.5% (7807)	13.1% (133)	
<b>Age</b>			
14 year	24.4% (3558)	13.0% (132)	< .001
15 year	25.3% (3694)	23.5% (238)	
16 year	25.6% (3729)	27.6% (279)	
17 year	24.7% (3609)	35.9% (363)	
<b>Nationality</b>			
Italian	94.8% (13 829)	95.3% (964)	.755
EU countries	1.4% (203)	1.4% (14)	
Other countries	3.8% (558)	3.4% (34)	
<b>Family's economic level</b>			
Not known	8.7% (1267)	9.1% (92)	< .001
Higher than friends' families	9.6% (1403)	14.7% (149)	
Same as friends' families	74.1% (10 816)	67.8% (686)	
Lower than friends' families	7.6% (1104)	8.4% (85)	
<b>Pocket money weekly</b>			
€ 0-20	76.9% (11 224)	55.7% (564)	< .001
€ 21-50	18.6% (2716)	28.4% (287)	
> €50	4.5% (650)	15.9% (161)	
<b>Academic performance</b>			
Poor	2.4% (348)	5.4% (55)	< .001
Average	70.5% (10 284)	77.3% (782)	
Good or very good	27.1% (3958)	17.3% (175)	
<b>Profile on a "social network"</b>			
No	2.9% (423)	2.3% (23)	.247
Yes	97.1% (14 167)	97.7% (989)	
<b>Smoking behavior</b>			
Never smoked	53.5% (7808)	29.2% (295)	< .001
Former smoker	2.0% (287)	3.9% (39)	
Occasional smoker	33.9% (4942)	40.9% (414)	
Daily smoker	10.6% (1553)	26.1% (264)	
<b>Alcohol drinking behavior</b>			
Never	26.9% (3924)	7.4% (75)	< .001
Sometimes, but less than once a month	29.9% (4359)	16.2% (164)	
Often, from every month to every day	43.2% (6307)	76.4% (773)	
<b>Energy drink consumption</b>			
Never	52.5% (7655)	26.8% (271)	< .001
Rarely	32.7% (4776)	37.5% (379)	
Frequently	14.8% (2159)	35.8% (362)	
<b>New psychoactive substances consumption</b>			
Never	96.5% (14 079)	86.3% (873)	< .001
Rarely	2.0% (286)	5.2% (53)	
Frequently	1.5% (225)	8.5% (86)	
<b>Coffee consumption</b>			
Never	23.5% (3424)	16.0% (162)	< .001
Rarely	19.9% (2905)	16.4% (166)	
Frequently	56.6% (8261)	67.6% (684)	

Table 3. Logistic regressions results for two outcomes.

	OR*	95% CI		p-value
		Lower limit	Upper limit	
O1 = at-risk gambler/ problem gambler				
Energy drinks				
Rarely	<b>1.28</b>	<b>1.08</b>	<b>1.52</b>	<b>.004</b>
Frequently	<b>1.95</b>	<b>1.62</b>	<b>2.34</b>	<b>&lt; .001</b>
New psychoactive substances				
Rarely	1.37	.99	1.89	.057
Frequently	<b>2.96</b>	<b>2.21</b>	<b>3.95</b>	<b>&lt; .001</b>
Coffee				
Rarely	1.10	.87	1.38	.446
Frequently	1.03	.85	1.25	.734
O2 = any gambling behavior				
Energy drinks				
Rarely	<b>1.44</b>	<b>1.32</b>	<b>1.58</b>	<b>&lt; .001</b>
Frequently	<b>1.75</b>	<b>1.57</b>	<b>1.95</b>	<b>&lt; .001</b>
New psychoactive substances				
Rarely	1.14	.90	1.44	.274
Frequently	<b>2.02</b>	<b>1.58</b>	<b>2.60</b>	<b>&lt; .001</b>
Coffee				
Rarely	1.09	.97	1.24	.157
Frequently	<b>1.20</b>	<b>1.09</b>	<b>1.33</b>	<b>&lt; .001</b>

Note. OR = Odds ratio; CI = Confidence Interval.

\*Regression analyses adjusted for the variables: sex, age, nationality, family's economic level, weekly pocket money, academic performance, smoking behavior, alcohol-drinking behavior.

average daily caffeine intake and scores on a risk-taking questionnaire (Ste-Marie, Gupta & Derevensky, 2006).

We also found an association between energy drink consumption and at-risk and problem gambling behavior in adolescence. Energy drinks contain 75-158 mg of caffeine per can, and these beverages have stimulant effects on the central nervous system (CNS). Their consumption is prompted by the expectation that they improve the drinker's physical and mental performance. In fact, through antagonism of the adenosine A1 and A2A receptors, caffeine combats the inhibitory effects of adenosine on dopamine, thus increasing the psychoactivity of the dopaminergic systems D1 and D2, with effects on mood, executive functioning, salience attribution, cognition, and regulation of behavior (Ishak, Ugochukwu, Bagot, Khalili & Zaky, 2012). Risk-taking behavior seems to be manifest in adolescence due to an enhanced sensation seeking related to functional changes in dopaminergic activity between childhood and adolescence (Arenas et al., 2016). In the past, it was demonstrated parallel and dominant role of dopamine in relation to the pathophysiology of gambling, and it could be described as psychostimulant-mimetic (Zack & Poulos, 2009). A recent review on energy drink consumption produced evidence of consumers being high risk-takers, and

more likely to exhibit lifestyle behaviors characterized by disinhibition and lack of moderation, including smoking, alcohol drinking, and caffeine consumption, as well as gambling (Verster et al., 2018).

Finally, our study demonstrates that at-risk and problem gambling in adolescence is associated with new psychoactive substances consumption. Little research has been done so far on the use of new psychoactive substances by teenagers. A study on college students showed that those who had used some kind stimulant substance in the previous 3 months had 74% higher odds of problem gambling in the previous 6 months (Geisner et al., 2016). Another study on 12- to 19-year-old high-school students in the USA also found that the use of any stimulant substance was associated with higher odds of more frequent gambling, and problem gambling among both males and females. The psychostimulant-mimetic model predicts that stimulant drugs cross-prime the motivation to gamble (Zack & Poulos, 2009). Consistently, Zack (2004) et al. provided experimental evidence of a neurochemical activation similar to that induced by psychostimulant drugs being an important feature of gambling addiction. A number of reports suggest that gambling can induce effects closely resembling those of a psychostimulant drug, and the profiles of an episode of gambling and psychostimulant use are also similar inasmuch as they both feature a marked behavioral perseveration (Dickerson, Hinchey & Fabre, 1987). Such evidence implies that psychostimulant drugs and engaging in gambling prompt much the same set of effects. If so, a dose of a psychostimulant drug may prime the motivation to gamble in much the same way as a 'dose' of gambling (Zack & Poulos, 2004). Neuroimaging research also indicates that the expectation or receipt of money induces selective patterns of activation in the brain's dopamine pathways (Knutson, Fong, Adams, Varner & Hommer, 2001). These pathways are also crucially involved in the reinforcing effects of psychostimulant drugs (Mackey & van der Kooy, 1985; Spyraiki, Fibiger & Phillips, 1982; Yokel & Wise, 1978). Another issue to consider is personality traits: feelings of alienation, anxiety, low self-esteem, and attitudes to deviance, independence and impulsivity could all potentially increase the risk of both problem gambling and stimulant drug use (Brezing, Derevensky & Potenza, 2010; Jessor, 1987; Romer, 2003; Secades-Villa, Garcia-Rodriguez, Jin, Wang & Blanco, 2015).

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

this potential bias, we guaranteed respondents' anonymity and confidentiality. Third, the cross-sectional design of this study limited our ability to draw causal inferences, particularly as regards the direction of the association between stimulant substance use and gambling, which might be two-way.

## Conclusion

The consumption by teenagers of stimulant substances like new psychoactive substances and energy drinks is associated with gambling at-risk/problem gambling. Adolescence is known to coincide with a natural surge in sensation-seeking and risk-taking behavior, and gambling and/or the use of stimulants may exacerbate this natural tendency with potentially negative psychological, social, and financial implications. Given the significant association identified between the use of stimulant substances and gambling activities in teenagers, it would be important to organize educational schemes that improve people's awareness of the overlaps in multiple types of risk-related behavior.

Mental health counselors, social workers, and psychologists working with secondary-school students and other teenagers need to bear in mind the significant associations between the risk-related behaviors. Screening adolescents for both gambling and stimulant use may provide useful information on what action we can take to reduce the consumption of stimulant substances by the young, also as part of our efforts to prevent and manage gambling problems.

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## Conflicts of interest

The authors have no financial or other relationships relevant to this article to disclose.

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