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The cards they're dealt: types of gambling activity, online gambling, and risk of problem gambling in European adolescents

Gabriele Lombardi [a], Sabrina Molinaro [b], Rodolfo Cotichini [b], Sonia Cerrai [b], Marco Scalese [b], Elisa Benedetti [b,*]

[a] Department of Statistics, Computer Science, Applications "Giuseppe Parenti" (DiSIA), University of Florence, Viale Giovanni Battista Morgagni 59, Florence, 50134, Italy
[b] Epidemiology and Health Research Lab, Institute of Clinical Physiology of the Italian National Research Council (CNR-IFC), Via Giuseppe Moruzzi 1, Pisa, 56124, Italy

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ABSTRACT

Objective: This study aims to identify risk factors associated with gambling engagement and the likelihood of problem behavior, distinguishing by type of gambling activity and examining the impact of online gambling.
Methods: Data about 85,420 students aged 16 from 33 countries participating in the 2019 European School Survey Project on Alcohol and Other Drugs (ESPAD) were analyzed through a three-stage sequential probit model, specifically focusing on four types of activity: lotteries, slot machines, cards, and betting. Furthermore, predicted probabilities were calculated for subsamples of students engaging in different types of gambling activities to explore their influence on the likelihood of problem gambling behavior, conditioned on online gambling involvement.
Results: Certain groups, such as males and those with a history of school difficulties, exhibit a higher likelihood of problematic gambling behavior. Online gaming significantly influences adolescent gambling behavior, with slot machines demonstrating the highest predicted probabilities of risky behavior when combined with online gaming.
Policy implications: The findings highlight that gambling is quite common among adolescents, and that gamblers and problem gamblers display different profiles, suggesting the importance of targeted interventions and support for vulnerable individuals. Public policies should prioritize the regulation of high-risk gambling activities, particularly slot machines, by enhancing the enforcement of age restrictions and the education on the real odds of winning and potential harms of gambling, particularly among adolescents. It is crucial to foster policies and interventions that address the risks associated with online gambling for this age group.

1. Introduction

Gambling disorder is a widely-researched topic, with studies suggesting that it shares characteristics with substance abuse (Blanco et al., 2001). The social costs associated with gambling are often borne by the most vulnerable members of society, particularly those with limited financial resources (Resce et al., 2019). In recent years, there has been increasing concern about adolescent gambling involvement, which has been facilitated by the greater availability and accessibility of gambling products. This has resulted in personal, social, and economic costs for younger generations (Hardoon and Derevensky, 2002). Adolescents who engage in gambling may experience feelings of guilt that can escalate into depression. Additionally, their involvement in gambling can lead to a lack of meaningful social experiences, which can disrupt their relationships with family and friends. Furthermore, they may face financial consequences, resorting to borrowing or even to theft in order to fuel their gambling habits (Livazović and Bojčić, 2019).

Research has identified some vulnerable groups that are particularly at risk of gambling-related problems, including individuals who have experienced difficulties in school, children of gamblers, and males (Winters et al., 1993). These groups are also more likely to be drawn to the current gaming culture (Lopez-Fernandez et al., 2019). However, recent findings suggest that high levels of support from families and institutions can help reduce the risk of problem gambling behavior among adolescents (Colasante et al., 2022). Specifically, Donati et al., 2023 highlight how the attitudes of families towards gambling serve as

* Corresponding author.
E-mail address: elisa.benedetti@cnr.it (E. Benedetti).

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an environmental factor in influencing the likelihood of children being at risk of problematic behavior, estimating a significant correlation about 0.20 between parents' and adolescents' gambling frequency.

The rise of online gambling has exacerbated this issue, as it has made gambling activities even more accessible to young people. Youth's proficiency in using social media and online tools increases their exposure to online gambling, particularly casino and poker games (Griffiths and Parke, 2010; Molinaro et al., 2020). Online products are also more addictive than traditional forms of gambling (Chòliz, 2016; Allami et al., 2021) and the number of young pathological gamblers has increased with the growth and promotion of online gaming. This is also due to the emergence of new tools that have deeply reshaped a consistent part of the videogames landscape. Nowadays, a significant number of videogames incorporate various forms of simulated gambling, which have been found to have a concerning association with an increased risk of engaging in real-money gambling in the future (Hing et al., 2022a). Research by King et al. (2020) suggests that approximately 80% of adolescents may be involved in simulated gambling, depending on the context, while around 5% of adolescents are estimated to experience problem gambling. Simulated gambling within online gaming, which has been positively linked to a higher risk of problem gambling, can be broadly categorized into two types: Loot Boxes and Skins gambling. Loot Boxes are a form of microtransaction that can be acquired either through gameplay or by purchasing them with real money, with the contents being randomly determined (Kristiansen and Severin, 2020). On the other hand, Skins gambling involves betting on E-sports using virtual goods, specifically cosmetic in-game items called "skins" (Hing et al., 2022b).

This study aims to identify risk factors associated with gambling engagement and the likelihood of problem behavior, distinguishing by type of gambling activity and examining the impact of online gambling. In fact previous research has highlighted the specific relevance of different gambling types among adolescents. Regarding slot machines, Griffiths (1991) hypothesized a mechanism of youth disorder. He suggested that television exposure during childhood, followed by gaming disorder in early adolescence, could lead youths to find both psychological and financial rewards in man-machine interactions, creating an optimal pathway to other forms of gambling disorder. More recent studies confirm that slot machines among adolescents are associated with excessive gambling (Reynolds et al., 2023), risky health behaviors (Mosconi et al., 2024), and even brain dysfunction linked to Internet Gaming Disorders (Imataka et al., 2022). On the other hand, a systematic review by González-Bueso et al. (2021) noted that the vast majority of gambling studies on adolescents identify card games as one of the preferred activities. This preference is largely due to the fact that this type of gambling activity requires real skills and can be engaged in privately with family and friends (King et al., 2020). Similar to card games, betting on sports and animals is characterized by a playful dimension, the necessity of specific skills, and the potential for both formal and informal gambling (DiCicco-Bloom and Romer, 2012). Furthermore, Mateo-Flor et al. (2020) emphasize that the increase in physical and virtual betting points, along with the rise of sponsorships of clubs and players by betting companies, is normalizing gambling behaviors among adolescents. Lastly, lotteries emerge as a particularly notable type of gambling activity. When Rockloff (2012) developed his Consumption Screen for Problem Gambling (CSPG), he suggested not including lotteries and scratch cards, likely due to the challenges in measuring the duration spent on these activities. However, it is now difficult to interpret lotteries and scratch cards as mere one-shot games, as they represent a significant source of state financing (Karcher, 2021; Kearney, 2005), leading to an increase in both the number of gambling products included in this category and daily draws. This is even more evident when considering the wide range of lotteries now available on the Internet, which allow for fast draws and immediate disclosure of results to gamblers. Accordingly, Zhai et al. (2021) and Ariyabuddhiphongs (2011) highlight the risks associated with lotteries for adolescents, particularly because they are so widespread and socially accepted, even by parents, compared to other gambling activities. Apart from game-specific associations, LaPlante et al. (2014) emphasize the importance of not limiting the focus to the *depth of involvement* (i.e., the frequency of playing), but also considering the *breadth of involvement*, which refers to the number of games played at the same time.

Our analyses are based on data from the 2019 ESPAD cross-sectional survey on European adolescents in 33 countries using an estimation strategy based on a three-stage sequential probit model, which is a special case of a recursive mixed-process model (Roodman, 2011). The second section of the article presents the results of the main model, and the third section discusses the predicted probabilities for subsamples based on four different types of gambling activity (lotteries, cards, betting, and slot machines) to explore their influence on the likelihood of problem gambling behavior, conditioned on online gambling involvement. Finally, the article concludes by highlighting the main public health implications of our findings.

2. Data and Methods

Data for this study were obtained from the ESPAD (European School Survey Project on Alcohol and Other Drugs) cross-sectional survey. This survey collects data on risk behaviors among adolescents in several European and neighboring countries every four years since 1995. The sample used in this study consisted of 85,420 individuals from 33 countries that participated in the 2019 data collection. The survey was administered via anonymous questionnaires to students in a classroom setting. The study methodology utilized nationally representative samples of students turning age 16 in the survey year, within randomly selected classes and schools. Participating countries comply with their respective national ethics and data protection regulations. Detailed information is provided in the dedicated methodology report (ESPAD Group, 2021).

2.1. Data

To determine the dependent variable of gambling, students were asked about the frequency of their gambling activity in general, as well as the types of gambling that they participated in over the last 12 months. For the purpose of this study, all the gambling types as specified in the ESPAD questionnaire were employed, namely: slot machines (fruit machines, new slots etc.), cards or dice (poker, bridge, dice etc.), lotteries (scratch, bingo, keno etc.), and betting on sports/animals (horses, dogs etc.). Gamblers were defined as those who gambled for money on at least one of the four included activities. The dependent variable of problem gambling was based on the Consumption Screen for Problem Gambling (CSPG) developed by Rockloff (2012), which measures gambling frequency, time spent on gambling, and gambling intensity. Those who scored 4 or more points on the CSPG were considered as being at risk of problem gambling based on the cut-off indicated in Rockloff (2012).

Despite the fact that Rockloff (2012) developed his CSPG for adults and discouraged the use of lotteries and scratch cards as gambling items, the structure of the questions in the ESPAD survey prevents us from employing a different scale. Nonetheless, previous studies have adopted the CSPG to analyze the ESPAD data (e.g. Reynolds et al., 2023; Spolc et al., 2019) or have included lotteries as relevant games for examining adolescent gambling behaviors (Castren et al., 2021; Roquer et al., 2024). Moreover, we assessed the appropriateness of our indicator in two ways. First, we tested internal consistency by computing Cronbach's Alpha ($\alpha = 0.869$). Then, we evaluated the suitability of synthesizing the information into a single indicator through Principal Component Analysis (Eigenvalue = 2.379; Variance accounted for = 0.793).

The analysis included several covariates (listed in Table 1): gender, perceived family support, perceived friends' support, missed school days, highest parental education, self-reported family well-off status

Table 1
Descriptive statistics by type of gambling activity.

	Full Sample	Betting	Cards	Slot-Machines	Lotteries
	%	%	%	%	%
Female	52.9	15.9	35.4	27.2	41.8
School Missed: 0 days	24.0	17.7	15.7	14.2	17.5
School Missed: 1–2 days	32.6	29.2	28.0	25.9	30.6
School Missed: 3–5 days	20.1	22.5	22.7	22.9	22.2
School Missed: 5+ days	23.3	30.6	33.6	37.0	29.7
Highest Parental Education: No HS	19.4	15.9	19.6	19.5	17.4
Highest Parental Education: HS	39.8	44.1	38.7	43.7	43.0
Highest Parental Education: Uni	40.8	40.0	41.7	36.8	39.6
Family Well-Off: Less off	8.5	8.2	8.5	9.2	8.9
Family Well-Off: About the same	46.2	41.1	39.0	39.2	43.7
Family Well-Off: Better off	45.3	50.7	52.5	51.6	47.4
Parental Monitoring: About Always	59.8	42.8	41.0	38.3	47.6
Parental Monitoring: Sometimes	28.3	34.7	34.5	34.5	33.2
Parental Monitoring: About Never	13.9	22.5	24.5	27.2	19.2
Parents give money: Seldom/Never	21.6	20.1	21.2	18.6	18.9
Parents give money: Often/Sometimes	47.9	45.8	47.5	46.4	47.6
Parents give money: Almost always	30.5	34.1	31.3	35.0	33.5
Online Gaming	6.6	53.6	69.7	55.9	74.0
Gamblers	21.7	–	–	–	–
At-Risk Gamblers	14.7	24.1	19.5	28.5	15.2
	Mean	Mean	Mean	Mean	Mean
Family Support Index	5.747	5.732	5.485	5.475	5.642
Friend Support Index	5.544	5.502	5.374	5.339	5.496
I-GPI$_{betting}$	−0.005	0.507	−0.338	0.233	0.152
I-GPI$_{cards}$	−0.007	0.183	0.249	0.240	0.149
I-GPI$_{slot}$	−0.011	0.362	0.034	0.557	0.095
I-GPI$_{lotteries}$	0.005	0.445	0.032	0.267	0.300
Number of Observations	85,420	8,176	7,404	3,933	9,514

compared to other families, parental monitoring indicator, and an indicator of how often parents give money to their children.

To estimate the prevalence and intensity of each gambling activity among adolescents within countries, we created the Individual Gambling Product Index (I-GPI). This index measures the quantity and frequency of peer gamblers surrounding our subjects in their respective countries, thus avoiding reflection bias (Manski, 1993):

$$I-GPI_{i,g}=\begin{cases}\dfrac{N_{c,g,ans_2}+24N_{c,g,ans_3}+104N_{c,g,ans_4}}{(N-1)_c}\ if\ ans_{1,i}=Yes,\\ \dfrac{(N-1)_{c,g,ans_2}+24N_{c,g,ans_3}+104N_{c,g,ans_4}}{(N-1)_c}\ if\ ans_{2,i}=Yes,\\ \dfrac{N_{c,g,ans_2}+24(N-1)_{c,g,ans_3}+104N_{c,g,ans_4}}{(N-1)_c}\ if\ ans_{3,i}=Yes,\\ \dfrac{N_{c,g,ans_2}+24N_{c,g,ans_3}+104(N-1)_{c,g,ans_4}}{(N-1)_c}\ if\ ans_{4,i}=Yes.\end{cases} \quad (1)$$

Where, c represents the country, g the type of gambling activity, ans_1 indicates if subjects have never participated in a certain gambling activity, ans_2 indicates if they participated in it only once in the last 12 months (i.e. 1 day), ans_3 indicates if they participated in it at least twice per month (i.e. 12 days), and ans_4 indicates if they participated in it at least twice per week (i.e. 104 days). N represents the number of individuals in our sample. The Individual Gambling Product Index (I-GPI) should be interpreted as an indicator of the average frequency of gambling on a specific activity within a particular country, excluding the specific individual to whom the indicator refers. In other words, the I-GPI provides an estimate of the prevalence and frequency of use of each gambling activity among peers within countries.

According to Table 1, nearly 22% of our sample participated in at least one form of gambling. Specifically, 9.6% have participated in betting activities, 8.7% in card games, 11.1% in lotteries, and only 4.6% in slot machines. Although the sample is balanced in terms of gender, females are consistently the minority across all types of gambling activities, with higher prevalence in lotteries (41.8%) and card games (35.4%). On average, 43.4% of our subjects missed more than three days of school, and among these, 56.3% participated in card games and 59.9% in slot machines. These are also the two gambling activities more frequently engaged in by students from low-educated families. In contrast, betting (84.1%) and lotteries (82.6%) are more commonly engaged in by those whose parents hold at least a secondary education degree. Surprisingly, the majority of gamblers come from families that perceive themselves as equally or more affluent than their peers, frequently providing money to their children, but without always being aware of where and with whom they are spending their time. Additionally, the majority of online gamblers have engaged in at least one type of gambling activity, with card games (69.7%) and lotteries (74%) being the most common. Remarkably, all gamblers exhibit a lower average perceived support from friends and family compared to the full sample, especially those who engaged in card gambling and slot machines. Examining the means for GPIs, reveals a positive association between the prevalence of young gamblers in a country and the likelihood of engaging in specific gambling activities, particularly betting and slot machines. Finally, the highest shares of gamblers at risk of problematic behavior are concentrated among those who engaged in betting (24.1%) and slot machines (28.5%).

2.2. Model

To examine the joint effect of gambling types and online gambling on adolescents' behavior and risk of problematic behavior, several issues need to be taken into account. Firstly, we need to consider those subjects who have never gambled to avoid selection biases in the analysis. Secondly, we need to include at least two stages in the analysis to include gambling types as covariates without encountering collinearity problems. Finally, to explore associations among different gambling activities, we need to perform separate analyses for each type of gambling. To address these issues, we used a three-stage sequential probit model, which is a special case of a recursive mixed-process model (Roodman, 2011).

In the first stage, we controlled for the characteristics of individuals who have engaged in any gambling activity against those who have never engaged by building a selection equation, which is similar to a Heckprobit model (Van de Ven and Van Praag, 1981). We used a probit model to estimate the probability of an individual i ($i = 1, \ldots, N$) engaging in gambling. This allowed us to mirror the relationship between the characteristics of those who have gambled and those who have not.

$$Pr\,(y_i=1)=\Phi\left(\beta_j^{'}X_{ij}+u_{ij}\right),\ j=\begin{cases}0\ if\ the\ subject\ is\ not\ a\ gambler\\ 1\ if\ the\ subject\ is\ a\ gambler\end{cases}. \quad (2)$$

After accounting for those who have never gambled in the first stage, we restricted the second stage to only include gamblers. We built a different probit model to estimate the probability of an individual

engaging in a specific gambling activity, denoted as g = [Betting, Cards, Slot-Machines, Lotteries]:

$$Pr\ (g_i = 1) = \Phi\left(\beta_k^{'} X_{ik} + u_{ik}\right),\ k = \begin{cases} 0\ \textit{if the subject has played g} \\ 1\ \textit{if the subject has not played g} \end{cases}. \quad (3)$$

In the third and final stage, we controlled for how the probability of at-risk problematic gambling behavior changes for those gamblers who have engaged in a specific gambling activity, as controlled for in stage 2. This was done by building separate models for each type of gambling activity:

$$Pr\ (p_i = 1) = \Phi\left(\beta_l^{'} X_{il} + u_{il}\right),\ l = \begin{cases} 0\ \textit{if the subject is not problematic} \\ 1\ \textit{if the subject is problematic} \end{cases}. \quad (4)$$

Similar to the standard Heckman model (Heckman, 1979), we needed to identify instrumental variables that are not relevant for all stages simultaneously. As individual characteristics are used in each equation, dichotomous variables for the three types of gambling activities not included as dependent variables in the second stage can only enter the third stage, which is the only one including online gaming as well. In addition, we included an interaction between online gambling and type of gambling activity in the third stage since the main aim of this study is to focus on these two factors.

On the other hand, stages 1 and 2 relied on environmental factors as instrumental variables (Montmarquette et al., 2001; Aina et al., 2022). Specifically, the first stage included country fixed-effects, which were substituted by Individual Gambling Product Indices (I-GPIs) for each type of gambling activity in stage 2. The assumption was that geographic characteristics may broadly influence the decision to start gambling (see, for example: Delfabbro et al., 2021; Gavriel-Fried et al., 2023), while specific gambling-related environmental factors impact the decision to engage i n a specific gambling activity.

For each of the four models, we estimated three correlation parameters $\widehat{\rho}_{12}, \widehat{\rho}_{13}, \widehat{\rho}_{23}$, where $s = 1,2,3$ indicates the stage number. We tested the null hypothesis $H_0 : \rho = 0$, and if we could not reject it, this would indicate that separate probit models would be sufficient to obtain consistent estimates (Miranda and Rabe-Hesketh, 2006).

3. Results

We start by comparing the four models, one for each type of gambling activity, starting with the first stage, which examines the probability of deciding to begin gambling. This is the only stage common to all four models, thus its results are consistent across them (as shown in Table 2, columns 1.1 and 2.1, and Table 3, columns 3.1 and 4.1). The resulting typical gambler profile is that of a male who perceives to be little supported by family but a lot by friends, misses many days of school, comes from an educated family, feels richer than his peers, is little monitored by parents, and often receives money from them. The only exception is in equation 4.1 (Table 3), where children from the highest educated families show no statistically significant differences compared to those from the lowest ones. This is not surprising, as the emerging picture suggests that wealth and money availability are crucial factors for adolescents deciding to gamble, and parental education level may be another proxy for wealth rather than a measure of families' cultural background. At this stage, across all four models, the residuals from the regressions are significantly correlated with the probability of being at risk of problematic behavior ($\widehat{\rho}_{13}$), as well as with the probability of engaging in a specific gambling activity, except for betting ($\widehat{\rho}_{12}$).

In the second stage (Table 2, columns 1.2 and 2.2, and Table 3, columns 3.2 and 4.2), significant differences in gambling behavior emerge considering the different types of gambling activities.

Betting gamblers (Table 2, column 1.2) are more likely to be male, lack family support but receive significant support from friends, frequently miss school days, and come from better-off families. Seemingly, parents have, at most, a secondary education level and do not closely monitor childrens' free time but provide them with money. Betting involvement is also more likely in countries where many peers play betting and few play slot machines and lotteries. There is no statistically significant association with living in countries with a high prevalence of cards or dice gamblers.

Moving on to card gamblers (Table 2, column 2.2), we observe no association with friends' support, or gender differences, likely due to the wide variety of gambling activities included in this broad category (from more ludic table games to poker). Nevertheless, students engaging in card gambling are less likely to come from medium-educated families and to perceive themselves as well-off as their peers. The associations with an elevated frequency of missed school days and low parental monitoring are instead confirmed. Money availability seems instead not relevant. Regarding environmental factors, card gamblers are more likely to reside in countries where this form of gambling is popular among peers and has a low prevalence of betting and lottery gamblers.

Slot machine gamblers (Table 3, column 3.2) tend to be males who do not feel supported by their families, frequently miss school days, come from low-educated families that do not monitor them but allow easy access to money. Interestingly, in this case family wealth is not statistically significant. From a geographical perspective, slot machine gamblers come from countries with few peers choosing betting, cards, and lotteries, but many preferring slot machines.

Lastly, lottery gamblers (Table 3, column 4.2) display a different profile. They are more likely to be females, perceive higher family support and lower friends' support. Moreover, the more school days missed, the less likely it is to gamble on lotteries. Remarkably, lotteries are the only gambling activity that is more likely to be played by those who are frequently monitored by their parents and less likely to be played by those who perceive themselves as better off than their peers. As for card gamblers, money access is not significant. Furthermore, living in a country with many gamblers of different games reduces the likelihood of choosing that specific game, while a high prevalence of lottery gamblers correlates positively with lottery participation.

The third stage (as shown in Table 2, columns 1.3 and 2.3, and Table 3, columns 3.3 and 4.3) estimates the likelihood of problematic gambling behavior, conditioned on both the decision to gamble and the decision to choose a specific gambling activity. The latter (second analysis stage) is correlated with the third stage for each of the four computed models ($\widehat{\rho}$_23).

Across all four models, males and students who are not or little monitored are more likely to be at risk of problematic gambling. Regarding family characteristics, parental education no longer plays a role, while perceived family support exhibits a negative association only in the case of lotteries. Friends' support is still positively linked with problematic gambling for both lottery and slot-machine gambling. Perceiving oneself as richer than peers increases the risk of problematic gambling with slot machines, while those who deem themselves poorer are more at risk with betting and cards. High money availability is consistently positively associated with problematic betting and lottery gambling, and not receiving money from parents is linked to the same risk for cards gambling, signaling that card gambling is the riskiest activity for those with lower economic status and resources. Concerning environmental factors, card, slot machine and lottery gambling are riskier when played in a country with high I-GPI for betting. At-risk lottery gambling also shows a positive association with countries where slot machine gambling is prevalent, just as at-risk betting gambling is associated with countries where lottery gambling is prevalent. Engaging in multiple gambling activities at the same time is also positively associated with the risk of problematic behavior, only lotteries do not show a significant association in the case of cards/dice at-risk gamblers.

Online gaming always shows a strong positive association with a higher risk of problematic gambling behavior.

In order to further investigate the relationships between the different

Table 2
Estimation results for Betting and Cards using Sequential Probit Model.

	Betting			Cards		
	(1)			(2)		
	Gambler	Betting Gambler	At-risk Betting Gambler	Gambler	Card Gambler	At-risk Card Gambler
	$\widehat{\beta}$ ($\widehat{\sigma}$)	$\widehat{\beta}$ ($\widehat{\sigma}$)	$\widehat{\beta}$ ($\widehat{\sigma}$)	$\widehat{\beta}$ ($\widehat{\sigma}$)	$\widehat{\beta}$ ($\widehat{\sigma}$)	$\widehat{\beta}$ ($\widehat{\sigma}$)
Female (*Ref: Male)*	−0.543***	−1.133***	−0.230***	−0.544***	0.020	−0.454***
	(0.035)	(0.053)	(0.073)	(0.035)	(0.056)	(0.062)
Family Support Index	−0.028***	−0.022***	−0.011	−0.027***	−0.046***	−0.001
	(0.006)	(0.008)	(0.014)	(0.006)	(0.006)	(0.017)
Friend Support Index	0.018***	0.022***	0.003	0.018***	−0.006	−0.010
	(0.005)	(0.008)	(0.013)	(0.005)	(0.007)	(0.013)
School Missed (Ref: 0 days)						
1–2 days	0.152***	0.124***	0.020	0.152***	0.054*	−0.009
	(0.014)	(0.032)	(0.036)	(0.014)	(0.030)	(0.053)
3–5 days	0.266***	0.231***	0.105***	0.270***	0.146***	−0.005
	(0.020)	(0.033)	(0.038)	(0.020)	(0.041)	(0.050)
5+ days	0.371***	0.318***	0.197***	0.375***	0.247***	0.0149**
	(0.027)	(0.034)	(0.048)	(0.027)	(0.041)	(0.060)
Highest Parental Education: (Ref: No High School)						
High School	0.089***	0.078**	0.008	0.088***	−0.085**	−0.021
	(0.026)	(0.035)	(0.042)	(0.026)	(0.041)	(0.051)
University	0.048*	0.024	−0.029	0.048*	0.012	−0.073
	(0.028)	(0.040)	(0.042)	(0.029)	(0.038)	(0.051)
Family Well-off (Ref: Less off)						
About the same	−0.015	0.015	−0.078*	−0.015	−0.069**	−0.147***
	(0.022)	(0.034)	(0.046)	(0.022)	(0.035)	(0.053)
Better off	0.067**	0.133***	−0.013	0.066**	0.033	−0.031
	(0.028)	(0.038)	(0.051)	(0.027)	(0.039)	(0.063)
Parental Monitoring (Ref: About Always)						
Sometimes	0.226***	0.194***	0.071*	0.226***	0.100***	−0.003
	(0.015)	(0.027)	(0.042)	(0.015)	(0.026)	(0.058)
About Never	0.352***	0.308***	0.261***	0.353***	0.280***	0.228***
	(0.028)	(0.032)	(0.039)	(0.028)	(0.034)	(0.057)
Parents give money (Ref: Seldom/Never)						
Often/Sometimes	0.079***	0.028	−0.050	0.083***	−0.002	−0.107*
	(0.013)	(0.023)	(0.034)	(0.013)	(0.026)	(0.055)
Almost Always	0.157***	0.157***	0.063**	0.164***	0.018	0.022
	(0.016)	(0.031)	(0.032)	(0.017)	(0.041)	(0.057)
$\text{I-GPI}_{\text{betting}}$	–	0.513***	−0.087	–	−0.099*	0.130**
		(0.064)	(0.073)		(0.052)	(0.061)
$\text{I-GPI}_{\text{cards}}$	–	−0.042	0.030	–	0.246***	−0.025
		(0.027)	(0.026)		(0.022)	(0.033)
$\text{I-GPI}_{\text{slot}}$	–	−0.063*	0.028	–	−0.007	0.038
		(0.038)	(0.039)		(0.041)	(0.055)
$\text{I-GPI}_{\text{lotteries}}$	–	−0.117***	0.170***	–	−0.183***	−0.022
		(0.042)	(0.051)		(0.034)	(0.054)
Betting	–	–	–	–	–	0.381***
						(0.070)
Cards	–	–	0.285***	–	–	–
			(0.075)			
Slot-Machines	–	–	0.393***	–	–	0.283***
			(0.043)			(0.068)
Lotteries	–	–	0.173**	–	–	0.068
			(0.088)			(0.062)
Online Gaming	–	–	0.576***	–	–	0.640***
			(0.052)			(0.074)
Online*Betting	–	–	–	–	–	−0.087
						(0.063)
Online*Cards	–	–	−0.054	–	–	–
			(0.063)			
Online*Slot-Machines	–	–	−0.054	–	–	0.105
			(0.052)			(0.090)
Online*Lotteries	–	–	0.033	–	–	0.106
			(0.059)			(0.080)
Constant	−1.130***	−1.064***	−1.575***	−1.150***	−0.152*	−1.201***
	(0.040)	(0.149)	(0.173)	(0.039)	(0.091)	(0.139)
Country Fixed Effects	Yes	No	No	Yes	No	No
Log-Likelihood		−53,915.332			−54,271,248	
$\widehat{\rho}_{12}$		−0.143			−0.051**	
		(0.100)			(0.020)	
$\widehat{\rho}_{13}$		0.730***			0.042***	
		(0.177)			(0.015)	
$\widehat{\rho}_{23}$		0.736***			0.025**	
		(0.165)			(0.012)	
Number of observations		85,420			85,420	

=". p < 0.1 * p < 0.05 * *p < 0.01 * **p < 0.001". Standard errors are clustered at survey level and observations are weighted.

types of gambling activities and how these change in association with the engagement in online gambling, Fig. 1 shows the predicted probabilities for the interaction between online gaming and each gambling activity of influencing the likelihood of problem gambling linked to a particular gambling type.

The analysis shows that slot machines, independently from the gambling activity they are combined with by adolescent gamblers, have the highest predicted probability of problem gambling behaviour, particularly when associated with betting in combination with the use of the online channel to gamble. This does not hold when analyzing problem gambling among card gamblers, where betting combined with online gambling by far achieves the highest predicted probability. Overall, lotteries are the least likely to be associated with problematic gambling, although the risk slightly increases when these are combined with the use of online platforms to gamble.

4. Discussion

While gambling has conventionally been viewed as a primarily adults' issue, the expansion of the gambling industry has led to a significant increase in gambling also among adolescents. Substantial evidence highlights the emergence of youth problematic gambling behavior as a public health issue also in European countries (King et al., 2020).

Very few studies adopted a comparative approach to explore how the different types of gambling activities, online gambling, as well as individual and country-level diffusion of adolescent gambling influence both the involvement of adolescents in gambling and the development of an at-risk gambling profile (Calado et al., 2017).

In this paper, we contribute to the literature analyzing these factors by exploiting a unique dataset that provides for the first time this information comparable across 33 European countries.

Our results produce a detailed picture of gambler and problem gambler profiles, providing useful information that can guide prevention and treatment efforts. They show that certain groups, such as males and those with low school connectedness, have a higher likelihood to engage in gambling and to be problem gamblers. The exception to this is lotteries, where it's more likely for girls to start playing, but for boys to be problem gamblers once they have started gambling. Friends' support seems to play a mixed role, acting as a risk factor for betting engagement as well as for problem gambling with slot machines and lotteries, a possible signal of peer pro-gambling attitudes (King et al., 2020). Confirming previous findings (Dowling et al., 2017), the lack of parental monitoring is a significant factor for both gambling and the likelihood of problem gambling across all analyses. When examining the prevalence of game-specific gambling in different countries using GPIs, there are indications of a phenomenon called the *telescoping effect*. This effect implies a quicker progression from the initiation of gambling to its problematic use (Haas and Peters, 2000). In simple terms, a high prevalence of gamblers for a specific gambling activity in a country increases the likelihood that individuals will choose that activity. However, this does not necessarily mean there is a higher probability of being a problem gambler. On the other hand, high prevalences of different gambling activities can negatively impact the likelihood of gambling on the baseline gambling activity, while simultaneously increasing the risk of gambling problems associated with it. To provide an example based on our findings, let's consider a country with a high prevalence of betting gamblers. In such a case, there may be lower chances of individuals starting to gamble on cards, slot machines, and lotteries. However, once someone does initiate gambling on these activities, the high prevalence of betting gamblers increases the likelihood of problematic gambling behavior associated with those activities.

The study's detailed analysis also highlights that, while gambling behaviors share common characteristics, not all gambling activities are equal and it is important to consider them when examining the risk factors of problematic behavior (King et al., 2020). In fact, betting, cards, slot machines and lotteries gamblers tend to have different risk profiles, with slot-machine gamblers being the most vulnerable group. The analysis also highlights the significant impact of online gambling in increasing the likelihood of problem behavior (Allami et al., 2021; King et al., 2020), independently from the gambling activity chosen. Additionally, the combination of online gaming and slot machines has the highest predicted probabilities of risky behavior.

These results serve as a more contemporary confirmation of Griffiths' (1991) hypothesis, which particularly linked slot machines to man-machine interaction, a concept that is also intrinsic to online gambling. Consistent with previous findings in the literature (see, for example, Griffiths, 1990; Donati et al., 2013; Supic et al., 2013), slot machine gamblers are at greater risk of gambling harm when they are male, poorly supported and monitored by their families, yet strongly influenced by friends and already engaged in multiple forms of gambling. Moreover, following the approach of LaPlante et al. (2014) in evaluating adolescents' involvement in multiple games, it is particularly noteworthy that those who engage simultaneously in card games, betting, and online gambling face a heightened risk. This combination merges man-machine interaction with activities that require significant skills (DiCicco-Bloom and Romer, 2012; King et al., 2020).

In summary, our results show that factors that increase the chance of gambling engagement are not necessarily relevant for generating problematic gambling behavior. Instead, low family support, high financial availability, and a social context with many slot machines and betting gamblers are more likely to trigger problematic behavior, with casino-style gambling activities being the most likely to induce such behavior, even in association with other forms of gambling.

The study's findings provide important insights into the factors associated with adolescent gambling behavior, highlighting the need for keeping high the awareness of the risks associated with online gaming and slot machines, also among adolescents (Chòliz, 2016; Gavriel-Fried et al., 2023).

4.1. Limitations and future directions

This study presented some limitations. First, findings were based on self-report data. Secondly, our assessment of problem gambling was not completely satisfactory, mainly because based on the Consumption Screen for Problem Gambling (CSPG) used in the ESPAD survey. Although the CSPG instrument has been shown to have a strong association with gambling-related harm, displaying satisfactory results in detecting problem gambling in adults (Dowling et al., 2019; Rockloff, 2012), it has not yet been validated in the adolescent population. Although the CSPG may be useful to identify possible problem gamblers, other extensive instruments are more frequently used and could therefore capture the phenomenon more clearly. However, as reported in the Data and Methods section, to the purpose of this study both internal consistency and suitability of this instrument for synthesizing the information into a single indicator were tested, displaying satisfactory results. Finally, the investigation of adolescent gambling in our study focuses on the four different types of activities investigated by the ESPAD questionnaire, but does not include emerging gambling formats such as loot boxes, skins betting and social casino games. Since these are largely legal for youth to engage in, they are often used much more than age-restricted formats. For this reason, gambling engagement and related harms could be underestimated and further research should devote a specific focus to emerging gambling formats.

5. Public health implications

The study findings emphasize the importance of targeting prevention and treatment interventions. Given the observed differences linked to the type of gambling activity chosen, prevention efforts should focus on educating students about the mechanisms and real odds of winning for each gambling activity. Among the environmental factors, perceived

Table 3
Estimation results for Betting and Cards using Sequential Probit Model.

	Slot-machines			Lotteries		
	(3)			(4)		
	Gambler	Slot Machine Gambler	At-risk Slot Machine Gambler	Gambler	Lottery Gambler	At-risk Lottery Gambler
	$\widehat{\beta}$ ($\widehat{\sigma}$)	$\widehat{\beta}$ ($\widehat{\sigma}$)	$\widehat{\beta}$ ($\widehat{\sigma}$)	$\widehat{\beta}$ ($\widehat{\sigma}$)	$\widehat{\beta}$ ($\widehat{\sigma}$)	$\widehat{\beta}$ ($\widehat{\sigma}$)
Female (*Ref: Male)*	−0.544***	−0.155*	−0.550***	−0.542***	0.610***	−0.734***
	(0.035)	(0.089)	(0.095)	(0.035)	(0.040)	(0.039)
Family Support Index	−0.027***	−0.042***	−0.023	−0.027***	0.012*	−0.031***
	(0.006)	(0.009)	(0.019)	(0.006)	(0.007)	(0.009)
Friend Support Index	0.018***	−0.006	0.032***	0.019***	−0.024***	0.027***
	(0.005)	(0.010)	(0.012)	(0.005)	(0.007)	(0.007)
School Missed (Ref: 0 days)						
1–2 days	0.153***	0.010	−0.049	0.154***	−0.100***	0.104***
	(0.014)	(0.039)	(0.077)	(0.014)	(0.025)	(0.024)
3–5 days	0.271***	0.087*	−0.110*	0.269***	−0.181***	0.177***
	(0.020)	(0.051)	(0.058)	(0.020)	(0.033)	(0.031)
5+ days	0.376***	0.212***	0.089	0.374***	−0.196***	0.322***
	(0.027)	(0.057)	(0.080)	(0.027)	(0.042)	(0.047)
Highest Parental Education: (Ref: No High School)						
High School	0.089***	−0.116***	0.047	0.090***	−0.019	0.028
	(0.026)	(0.033)	(0.095)	(0.025)	(0.033)	(0.033)
University	0.048*	−0.147***	−0.000	0.045	−0.037	−0.019
	(0.029)	(0.045)	(0.076)	(0.028)	(0.028)	(0.051)
Family Well-off (Ref: Less off)						
About the same	−0.015	−0.071	−0.012	−0.017	−0.021	−0.026
	(0.022)	(0.054)	(0.074)	(0.023)	(0.030)	(0.044)
Better off	0.067**	0.030	0.130**	0.068**	−0.084***	0.059
	(0.027)	(0.047)	(0.065)	(0.027)	(0.031)	(0.039)
Parental Monitoring (Ref: About Always)						
Sometimes	0.226***	0.067*	0.064	0.224***	−0.106***	0.108***
	(0.015)	(0.038)	(0.055)	(0.156)	(0.027)	(0.036)
About Never	0.353***	0.245***	0.338***	0.346***	−0.169***	0.292***
	(0.028)	(0.064)	(0.061)	(0.027)	(0.053)	(0.047)
Parents give money (Ref: Seldom/Never)						
Often/Sometimes	0.082***	0.004	−0.081	0.080***	0.003	−0.012
	(0.014)	(0.040)	(0.081)	(0.014)	(0.019)	(0.028)
Almost Always	0.163***	0.107**	0.063	0.159***	−0.030	0.079**
	(0.018)	(0.049)	(0.085)	(0.017)	(0.029)	(0.036)
I-GPI$_{betting}$	–	−0.227**	0.178***	–	−0.207***	0.193***
		(0.092)	(0.065)		(0.044)	(0.047)
I-GPI$_{cards}$	–	−0.104**	0.016	–	−0.064***	0.022
		(0.041)	(0.029)		(0.019)	(0.018)
I-GPI$_{slot}$	–	0.564***	−0.059	–	−0.099***	0.080***
		(0.073)	(0.078)		(0.027)	(0.026)
I-GPI$_{lotteries}$	–	−0.174***	0.102	–	0.264***	−0.062
		(0.065)	(0.068)		(0.059)	(0.063)
Betting	–	–	0.411***	–	–	0.251***
			(0.074)			(0.070)
Cards	–	–	0.204**	–	–	0.242***
			(0.083)			(0.067)
Slot-Machines	–	–	–	–	–	0.243***
						(0.068)
Lotteries	–	–	0.188*	–	–	–
			(0.108)			
Online Gaming	–	–	0.712***	–	–	0.451***
			(0.073)			(0.123)
Online*Betting	–	–	−0.147*	–	–	−0.051
			(0.078)			(0.050)
Online*Cards	–	–	0.037	–	–	−0.062
			(0.113)			(0.048)
Online*Slot-Machines	–	–	–	–	–	0.004
						(0.058)
Online*Lotteries	–	–	0.049	–	–	–
			(0.143)			
Constant	−1.158***	−0.315	−1.523***	−1.147***	1.129***	−1.628***
	(0.040)	(0.197)	(0.139)	(0.040)	(0.157)	(0.263)
Country Fixed Effects	Yes	No	No	Yes	No	No
Log-Likelihood	−50,122.639			−54,530.093		
$\widehat{\rho}_{12}$	−0.315*			−0.886***		
	(0.156)			(0.090)		
$\widehat{\rho}_{13}$	−0.337**			0.787***		
	(0.127)			(0.066)		
$\widehat{\rho}_{23}$	−0.231*			−0.803***		
	(0.122)			(0.112)		
Number of Observations		85,420			85,420	

=". p < 0.1 * p < 0.05 * *p < 0.01 * **p < 0.001". Standard errors are clustered at survey level and observations are weighted.

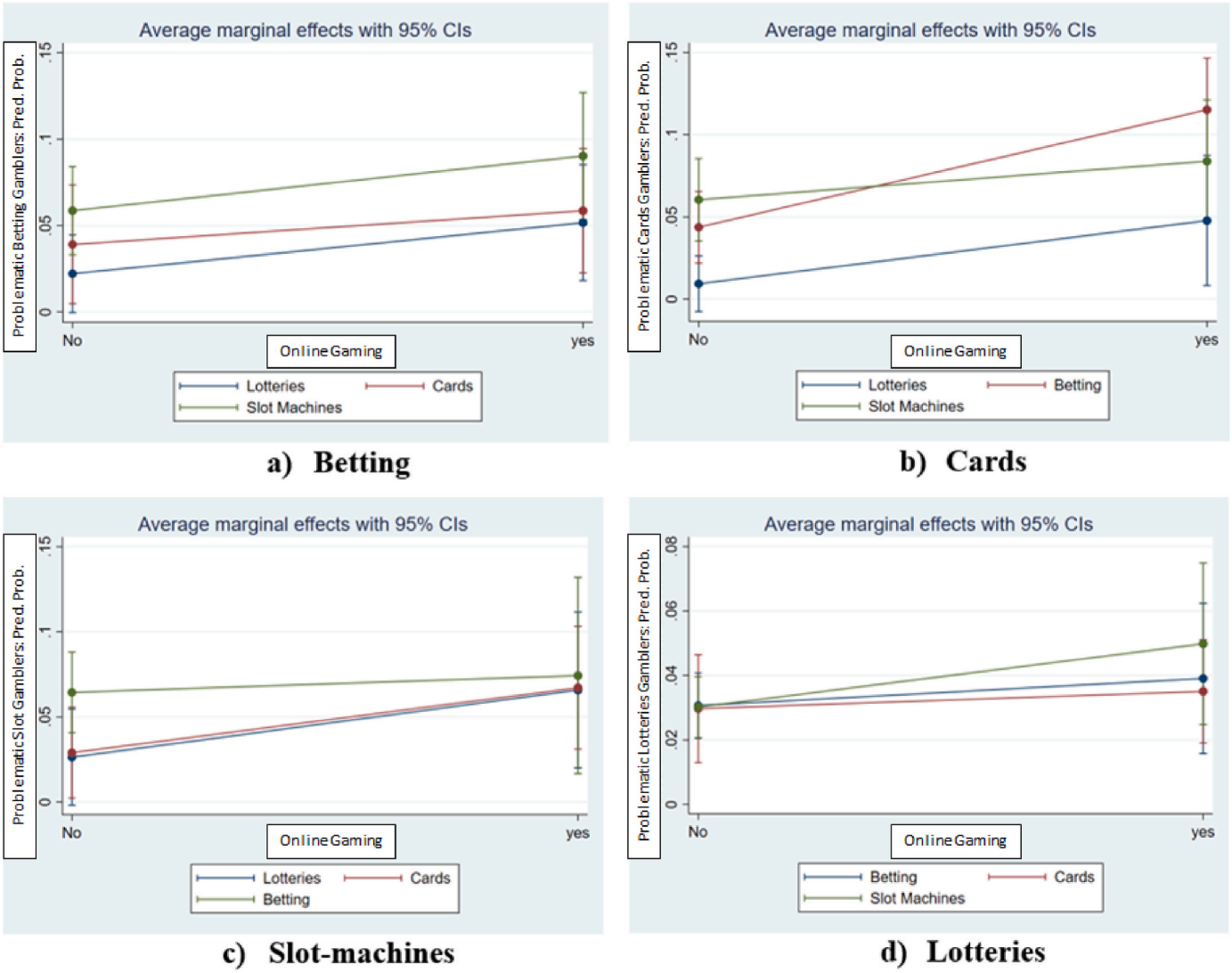

Fig. 1. Marginal Effect for each gambling activity conditioned for online gaming (C.I. 95%).

lack of family support and high pocket money availability, together with low school connectedness seem the most relevant to be addressed. These interventions can help minimize the negative social and economic consequences of gambling among adolescents.

Given the high prevalence observed, policymakers should prioritize an effective implementation of legal barriers for gambling, especially for slot machines and card games, that have a higher risk of problematic gambling behavior. A stricter enforcement of age restrictions and access limitations to these gambling activities, especially online, is therefore needed. Moreover, policymakers wishing to enhance education and awareness campaigns regarding the potential harms of gambling, should put a particular emphasis not only on programmes targeting not only adolescents, but also their families.

Lastly, the study emphasizes the importance of coordinated, cross-national strategies and policies to tackle adolescent problem gambling. Policymakers from different countries can collaborate to develop consistent regulations and policies regarding adolescent problem gambling, particularly concerning online gambling and gambling activities that carry a higher risk of problematic behavior. This would enhance adolescents' protection from gambling-related harm, regardless of their geographical location or access to gambling platforms.

CRediT authorship contribution statement

Gabriele Lombardi: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Sabrina Molinaro:** Writing – review & editing, Supervision, Resources. **Rodolfo Cotichini:** Formal analysis, Data curation. **Sonia Cerrai:** Project administration, Data curation. **Marco Scalese:** Project administration, Data curation. **Elisa Benedetti:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Data curation, Conceptualization.

Ethics statement

Our analysis is secondary and uses public-use ESPAD data, which is exempt from ethics review.

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Data availability

Data will be made available on request.

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