



OPEN The relationship between perceived parental knowledge and adolescent gambling

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This study revisits and extends prior evidence on the role of adolescents' perceived parental knowledge—how much they believe their parents know about their whereabouts and companions—in reducing gambling through attitudes and peer norms. Using two waves of the nationally representative survey ESPAD® Italia (2022–23; $N = 24,631$), we re-examine this relationship after major societal and digital shifts, including the COVID-19 pandemic and the expansion of online gambling platforms. Our results confirm that higher perceived parental knowledge is associated with lower gambling frequency, both directly and indirectly via increasing risk perception of gambling and decreasing descriptive norms on gambling shared with friends. Extending earlier work, we also test adolescents' awareness of legal gambling age limits as an additional normative pathway, examine heterogeneity by gender and legal gambling status, and analyze online gambling frequency. The results are robust across all specifications, suggesting that, even in evolving technological and social contexts, perceived parental knowledge continues to play an important role in buffering adolescents' gambling.

Keywords Perceived parental knowledge, Adolescence, Gambling, Descriptive norms, Attitudes

Parents influence adolescents' risk and addictive behaviors not only through direct monitoring and behavioral modeling^{1–5}, but also via indirect pathways such as knowing where their children are and who they are with^{6,7}. Even just adolescents' *perceived* parental knowledge (PPK, hereinafter)—i.e., their *perception* of how much parents know about their whereabouts and companions—is linked to reduced engagement in risk behaviors, including substance use^{8,9} and gambling^{10,11}. Adolescents' and parents' reported measures of parental knowledge have been shown to be positively and significantly correlated, supporting the validity of PPK as a reliable indicator of actual parental knowledge and monitoring⁸.

A key contribution on the relationship between PPK and gambling is Canale et al.¹⁰, who analyzed ESPAD Italia 2012 (European School Survey Project on Alcohol and Other Drugs) data from a nationally representative sample of 19,573 Italian adolescents aged 15–19 years (mean age ≈ 17.1 years; 54% female). They found that adolescents who perceived higher levels of parental knowledge were (i) more likely to disapprove of gambling, (ii) more aware of its harmfulness, and (iii) less likely to perceive their friends as gamblers—which were all, in turn, negatively related to their gambling frequency.

At the time of this study (2026), roughly a decade had elapsed since Canale et al.¹⁰. In the meantime, several major societal and technological changes have occurred, among which the COVID-19 pandemic likely had the most profound impact on adolescents^{12–14}. Moreover, the landscape of adolescent gambling has changed substantially, with an overall increase in participation, the rapid expansion of online gambling platforms, and the growing availability of gambling-like games and gaming features, particularly loot boxes^{15–19}.

In the Italian context, these changes should be viewed in light of the evolution of the gambling market, which is one of the largest in Europe and operates as a state-controlled system in which private operators run services under concession²⁰. Since the late 1990s, a series of reforms has expanded the supply of gambling products and progressively liberalized the market, including the legalization of online gambling in 2011²¹. More recently, policy has shifted toward a stronger public health approach, with measures such as the inclusion of gambling disorder among health conditions eligible for free care and treatment by the Italian healthcare system, the reduction of electronic gambling machines, and a comprehensive ban on gambling advertising aimed at protecting vulnerable groups, especially minors²². At the same time, the availability of online gambling has continued to grow, albeit under stricter access and player-protection requirements²⁰.

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Despite this increasingly protective regulatory framework, enforcement and prevention remain challenging. Recent data¹⁵ indicate that the prevalence of past-year gambling increased from 40% in 2016 to 57% among Italian students aged 15–19 in 2024, with 11% displaying behaviors consistent with at-risk or problem gambling. Over the last decade, online gambling has also become increasingly relevant in adolescent environments: in Italy, 13% of students in this age group report gambling online for money in 2024, compared to 8% in 2016¹⁵—a non-negligible figure comparable to that observed in most other European countries¹⁷. Unlike some land-based activities, online gambling may be less visible to parents and therefore represents a particularly important context in which to reassess whether PPK remains associated with gambling frequency²³.

Furthermore, although boys continue to report higher gambling participation than girls, gender differences have recently narrowed in Italy, largely due to an increase among females (from 30% vs. 50% in 2016 to 49% vs. 65% in 2024, respectively¹⁵). These trends may interact with gendered responses to disruptive events such as COVID-19¹⁴ and broader gender differences in risk-taking behavior²⁴, making it important to account for them.

Despite the growing policy focus on minors and the increasingly protective regulatory framework, the prevalence of gambling among Italian students aged 15–17 increased from 37% in 2016 to 55% in 2024¹⁵. Although the prevalence among students aged 18–19 is similar (62%), adolescents' gambling behavior may differ depending on the legal gambling environment in which they are situated²⁵. Legally eligible adolescents may have greater autonomy and more opportunities to gamble, potentially increasing exposure to risk and altering the mechanisms through which PPK affects gambling behavior²⁶.

Taken together, these changes indicate that adolescents are now exposed to a gambling environment substantially different from that of a decade ago, making it important to revisit whether previously identified mechanisms still hold.

We therefore use more recent data—ESPAD Italia 2022–23—to reassess the relationship between PPK and adolescent gambling. To preserve comparability with earlier research, we retain the core mediating pathways examined by Canale et al.¹⁰—namely, perceived harmfulness of gambling and perceived peer gambling—while extending the framework in three directions. First, we introduce a novel normative pathway, i.e., adolescents' awareness of legal gambling age limits, through which higher PPK may reduce gambling frequency. Second, we analyze heterogeneity by gender and legal gambling status. Third, we estimate an extension in which the outcome is online gambling frequency. Italy provides a particularly relevant case study, both for temporal comparison and because it remains one of the European countries with the largest gambling markets and the highest prevalence of adolescent gambling¹⁷.

Results

Sample and descriptive statistics

Our sample consists of 24,631 Italian students (2022: $N = 12,406$; 2023: $N = 12,225$), aged 15–19 years, with a mean age of 16.84 years ($SD = 1.44$) and 51.35% female (2022: 52.76%; 2023: 49.93%). Considering the Italian minimum legal gambling age of 18 years, participants are classified as underage aged 15–17 years (64.35%) or legally eligible adolescents aged 18–19 years (35.65%).

Supplementary Table S1 reports the frequency of gambling groups by gender and legal gambling status in the 2022–23 sample. Participants are mostly non-gamblers (44.12%), followed by occasional gamblers (36.54%), monthly gamblers (12.93%), and frequent gamblers (6.41%). More girls than boys are non-gamblers (50.27% vs. 37.33%) and occasional gamblers (38.78% vs. 34.79%), whereas boys show higher rates of monthly (17.36%) and frequent (10.52%) gambling compared to girls (8.65% and 2.30%, respectively). By legal gambling status, underage adolescents (15–17 years) are slightly more likely to be non-gamblers (45.82%) than legally eligible adolescents (18–19 years; 41.14%), who in turn exhibited higher rates of occasional (37.14%), monthly (13.80%), and frequent (7.91%) gambling (vs. 36.19%, 12.43%, and 5.55% among those underage).

Supplementary Table S2 reports the means, standard deviations, and bivariate correlations among the study variables. All observed relationships followed the expected direction (see “The Conceptual Model” Section). Specifically, higher PPK is associated with lower gambling frequency ($r = -0.15$), lower perceived peer gambling ($r = -0.12$), higher perceived harmfulness of gambling ($r = 0.07$), and greater awareness of gambling age limits ($r = 0.05$). In turn, gambling frequency is negatively correlated with perceived harmfulness ($r = -0.20$) and awareness of gambling age limits ($r = -0.03$), and positively with perceived peer gambling ($r = 0.32$).

Main results

Table 1 reports the results from the structural equation models described in the Methods. We first estimate the models using the full sample (Columns 1 and 4) and subsequently test them in the calibration (Columns 2 and 5) and validation (Columns 3 and 6) subsamples. Columns 1–3 report the benchmark specification—including perceived harmfulness of gambling and perceived peer gambling as mediators; Columns 4–6 extend it by incorporating awareness of gambling age limits as an additional mediator.

Direct effect

The direct association between PPK and gambling frequency (GF) is negative and statistically significant across all model specifications, with estimated coefficients ranging from -0.081 to -0.111 .

Indirect effects

(1) Higher PPK is associated with lower perceived peer gambling (PPG), which is linked to increased gambling frequency. The corresponding indirect effect ranges from -0.033 to -0.040 . (2) Higher PPK increases perceived harmfulness (PHG), which subsequently reduces gambling frequency, yielding an indirect effect between -0.005 and -0.016 . Finally, (3) higher PPK is associated with a greater awareness of legal gambling age limits (ALG), which is linked to lower gambling frequency. The indirect effect ranges from -0.003 to -0.004 .

Direct effects	Indirect effects (through)	Benchmark			Extension (Benchmark + ALG)		
		Full Sample	Partition 2 (Calibration)	Partition 3 (Validation)	Full Sample	Partition 2 (Calibration)	Partition 3 (Validation)
		(1)	(2)	(3)	(4)	(5)	(6)
PPK -> PPG		-0.113***	-0.152***	-0.123***	-0.113***	-0.151***	-0.122***
		(0.013)	(0.019)	(0.024)	(0.013)	(0.019)	(0.024)
PPK -> PHG		0.065***	0.113***	0.064**	0.065***	0.114***	0.064**
		(0.014)	(0.023)	(0.023)	(0.014)	(0.023)	(0.023)
PPK -> ALG					0.064***	0.045*	0.059**
					(0.012)	(0.019)	(0.022)
PPK -> GF		-0.098***	-0.086***	-0.111***	-0.093***	-0.081***	-0.108***
		(0.011)	(0.019)	(0.020)	(0.011)	(0.019)	(0.020)
	PPG	-0.033***	-0.039***	-0.036***	-0.034***	-0.040***	-0.036***
		(0.004)	(0.006)	(0.007)	(0.004)	(0.006)	(0.007)
	PHG	-0.007***	-0.016***	-0.005*	-0.007***	-0.016***	-0.005*
		(0.002)	(0.004)	(0.002)	(0.002)	(0.004)	(0.002)
	ALG				-0.004**	-0.003*	-0.003
					(0.001)	(0.001)	(0.002)
	Total Ind.	-0.040***	-0.056***	-0.041***	-0.044***	-0.060***	-0.044***
		(0.004)	(0.007)	(0.008)	(0.005)	(0.008)	(0.008)
	Total Eff.	-0.138***	-0.142***	-0.152***	-0.137***	-0.141***	-0.152***
		(0.012)	(0.020)	(0.021)	(0.012)	(0.020)	(0.021)
PPG -> GF		0.294***	0.258***	0.292***	0.299***	0.266***	0.294***
		(0.012)	(0.022)	(0.023)	(0.012)	(0.022)	(0.023)
PHG -> GF		-0.108***	-0.145***	-0.075**	-0.106***	-0.141***	-0.073**
		(0.012)	(0.024)	(0.023)	(0.011)	(0.024)	(0.024)
ALG -> GF					-0.060***	-0.077***	-0.055*
					(0.013)	(0.022)	(0.026)
R ² PPG		0.080	0.084	0.090	0.080	0.084	0.090
R ² PHG		0.020	0.033	0.033	0.019	0.033	0.033
R ² ALG					0.048	0.038	0.063
R ² GF		0.181	0.164	0.182	0.186	0.172	0.185
Observations		24,631	8,208	8,202	24,631	8,208	8,202

Table 1. Structural equation model for gambling frequency. Notes: We report the standardized coefficients. PPK=Perceived Parental Knowledge; PHG=Perceived Harmfulness of Gambling; ALG= Awareness of Legal Gambling Age Limits; PPG=Perceived Peer Gambling; GF=Gambling Frequency. * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$.

Total effect

Summing across paths, the total indirect effect is between -0.040 and -0.060 ($p < 0.001$), and the total effect (direct plus indirect) is between -0.137 and -0.152 ($p < 0.001$).

Mediation share

According to our findings, between 29% and 39% of the total association between PPK and gambling frequency is mediated by perceived harmfulness and perceived peer gambling. When we include awareness of legal gambling age limits as a third mediator, the proportion of the total effect explained by indirect pathways increases by approximately 3%.

Extensions

We examined whether the mediation pathways differ by gender and legal gambling status, and whether the same framework also applies when the outcome is online gambling frequency (Supplementary Tables S3, S4, and S5, respectively). Overall, the results are highly consistent with the main model: across all specifications, higher PPK remains associated with lower gambling frequency through both total and combined indirect effects.

Among the mediators, perceived peer gambling emerges as the most robust and consistent pathway across all extension analyses, including the online gambling specification. By contrast, the role of the other mediators shows greater heterogeneity across gender, legal gambling status, and online gambling frequency, as discussed in the next section. Differences by legal gambling status are comparatively modest overall, although coefficients are generally larger among underage adolescents than among legally eligible adolescents.

Discussion

This study reassesses the relationship between adolescents' PPK and gambling behavior using two recent waves of the ESPAD Italia survey (2022–23). The findings confirm that higher PPK is associated with lower gambling frequency, both directly and indirectly through adolescents' perception of peer gambling and beliefs about the harmfulness of gambling. These results suggest that associations previously documented in the literature¹⁰ continue to hold despite major social and technological changes that have reshaped adolescents' gambling environment over the past decade¹⁷, including the COVID-19 pandemic and online gambling, which may be less directly observable to parents.

Although the mechanisms through which parents acquire such knowledge—whether through child disclosure, parental solicitation, or other family dynamics—remain debated²⁷, previous research consistently indicates that when parents are informed about adolescents' activities and social environments, or when adolescents perceive that parents possess such knowledge, adolescents are less likely to engage in risky behaviors, including gambling⁸.

The present study also extends previous research in three directions. First, it examines whether awareness of legal gambling age limits represents an additional normative pathway linking PPK to gambling behavior. Second, it explores heterogeneity by gender and legal gambling age. Third, given the rapid expansion of digital gambling opportunities, it specifically investigates online gambling frequency.

Among the mediating mechanisms examined, perceived peer gambling emerged as the most consistent pathway across all analyses. Previous studies suggest that adolescents frequently overestimate peer involvement in risky behaviors, including substance use and gambling²⁸. According to the Social Learning Theory²⁹, such normative misperceptions may reinforce personal engagement in gambling. Our findings suggest that PPK may counteract these mechanisms, as adolescents reporting higher PPK also tended to perceive gambling as less common among peers, which in turn is associated with lower gambling frequency. One possible explanation is that higher PPK helps adolescents develop a more realistic understanding of peer gambling behaviors, thereby reducing normative pressure and the perception that gambling is a socially widespread or accepted activity.

Risk perception showed a weaker mediating role, remaining significant primarily among males, whereas awareness of legal gambling age limits was overall significant only among females. The stronger mediating role of risk perception among males may reflect broader evidence suggesting that male adolescents are more likely to engage in reward-oriented and sensation-seeking behaviors, making perceptions of gambling-related harm particularly relevant in shaping gambling involvement³⁰. This finding is especially relevant from a prevention perspective, as the gambling industry increasingly frames gambling as a harmless entertainment to shape public and policy perceptions and attract new consumers³¹. In contrast, the mediating role of legal age awareness among females may indicate their greater responsiveness to normative and regulatory factors, including legal age restrictions. More generally, the observed gender differences in gambling involvement and mediation pathways are consistent with evidence suggesting that adolescent gambling is shaped by partially distinct psychosocial mechanisms in males and females, including differences in sensation seeking, perceived risks, and responsiveness to social and contextual influences³².

Interestingly, when analyses focused specifically on online gambling, both the direct and indirect effects of awareness of legal gambling age limits disappeared. This finding is particularly relevant for public health policies. Evidence suggests that population-level regulatory measures are among the most effective strategies for reducing gambling-related harms³¹. However, this result, coupled with the growing diffusion of online gambling among adolescents, may indicate that, despite increasing regulatory attention to the protection of minors in Italy over the last decade, the enforcement of legal age restrictions in online environments remains inconsistent and insufficient.

Overall, these results have important implications for the prevention of adolescent gambling. They support prevention strategies that extend beyond adolescents themselves and actively involve key adult reference figures, especially parents, similar to established prevention approaches for substance use^{2,33}. Prevention programs should therefore not only aim to reduce individual risk factors and strengthen protective factors among adolescents but also target adolescents' proximal social environment by increasing parental awareness of gambling-related risks, the actual diffusion of gambling behaviors among youth, and existing gambling regulations and age restrictions.

The findings further suggest that adolescent gambling prevention programs may benefit from gender-sensitive approaches. Interventions emphasizing gambling-related harms and risk awareness may be particularly relevant for males, whereas strategies focused on normative and regulatory aspects, including legal age restrictions, may be more effective for females.

This study should be interpreted in light of some limitations. First, the cross-sectional nature of the data does not allow conclusions about causal relationships. In addition, the use of self-reported gambling behaviors and attitudes may be subject to potential recall bias. Relatedly, it relies on adolescents' self-reported perceptions of parental knowledge rather than direct measures of parents' actual monitoring behaviors or objective knowledge of adolescents' activities. The broader literature on parental monitoring has long emphasized that adolescents' perceptions of parental awareness themselves shape feelings of supervision, accountability, and behavioral boundaries, independently of whether parents possess complete or accurate information²⁷. Consistent with this perspective, prior research has shown that adolescent- and parent-reported measures of parental knowledge are positively and significantly correlated⁸. However, in some contexts, these measures might differ³⁴. This opens the way for future studies combining adolescents' and parents' reports to help compare perceived and actual parental knowledge, hence providing a more comprehensive understanding of the mechanisms linking family environments and adolescent gambling.

A further limitation of the present study is that the assessment of adolescent gambling behavior was limited to the activity categories included in the ESPAD Italia questionnaire and did not include emerging gambling-like products at the interface between gaming and gambling, such as loot boxes, skin betting, and social casino

games. As these activities have become increasingly prominent among adolescents and are often more accessible than traditional age-restricted gambling products, their exclusion may have led to an underestimation of overall gambling engagement. Future research should therefore incorporate gambling-like gaming activities to better capture contemporary youth gambling behaviors.

An additional limitation is the absence of direct measures of gambling problems or gambling-related harms. In the present study, we deliberately focused on gambling frequency rather than disordered gambling symptoms, as the sample consisted of adolescents aged 15–19 years, many of whom are likely to be in the early stages of gambling involvement. In this age group, severe gambling-related harms and clinically significant gambling disorders remain relatively uncommon and may not yet be fully observable, even among frequent gamblers, since adverse consequences often emerge progressively over time¹⁹. Although gambling frequency should not be considered equivalent to problem gambling, previous research has consistently linked higher gambling frequency to an increased risk of later gambling-related harms and problematic gambling trajectories^{35–38}. For this reason, gambling frequency is commonly used in adolescent research as an early behavioral indicator of gambling involvement and future vulnerability^{2,38}. Future studies including adolescents who already meet criteria for problem gambling could help clarify whether the mechanisms identified in the present study also apply with similar strength to more severe gambling profiles. Relatedly, longitudinal studies tracking adolescents into early adulthood could help determine whether PPK reduces the risk of subsequent gambling-related problems and harm.

Finally, as ESPAD[®] Italia includes only high school students, the findings may not fully generalize to out-of-school adolescents, who may display different gambling patterns. However, this limitation is partly mitigated by the high school enrolment rate among Italians aged 15–19 years, which was close to 90% in 2022–2023, supporting the broad representativeness of the sample for this age group.

Methods

Survey

Data were drawn from two consecutive waves (2022–23) of the ESPAD[®] Italia study, a nationally representative cross-sectional survey conducted annually by the Institute of Clinical Physiology of the Italian National Research Council (CNR) to investigate risk behaviors, such as substance use and gambling, in the Italian adolescent population.

A representative sample of high school students aged 15–19 years was obtained through multistage stratified random sampling, using geographical area and school type as stratification variables, with classes as the final sampling unit. Within each school, one or more classes from the first to fifth grade were selected. Passive parental consent was used, with information letters provided to schools, parents or guardians, teachers, and students outlining the study's characteristics and voluntary participation, with students free to withdraw at any time.

In both 2022 and 2023, 85% of invited schools agreed to participate, corresponding to 142 schools in 2022 and 146 schools in 2023. Data collection took place in school classrooms, ensuring anonymity and voluntary participation. Presence in class on the day of data collection served as the inclusion criterion, whereas the only exclusion criterion was the inability to complete the questionnaire independently, for instance, due to specific support needs. Among the eligible population, the participation rate was 99% in both survey years. Geographical area, age, and sex-based post-stratification weighting was applied in accordance with the target population's distribution (for more methodological details, see¹⁵).

The conceptual model

We build on the mediation framework proposed by Canale et al.¹⁰, linking PPK to adolescents' gambling frequency through gambling-oriented attitudes. In their study, PPK reduced gambling primarily indirectly via three attitudinal/normative channels—self-disapproval of gambling, higher perceived harmfulness, and lower perceived peer gambling. In our study, we retain perceived harmfulness of gambling and perceived descriptive peer norms as mediators, operationalized using the same ESPAD items.

Self-disapproval of gambling was no longer collected in the 2022–23 waves. Hence, in addition to estimating a benchmark specification with perceived harmfulness of gambling and perceived peer gambling, we extend the original framework by introducing a novel, distinct normative pathway, namely, adolescents' awareness of legal gambling age limits. This measure combines items assessing whether various gambling activities are considered legally prohibited for adolescents below the legal gambling age of 18 years.

Across both specifications, the hypothesis is the same: higher PPK is expected to reduce gambling frequency both directly and indirectly. Specifically, higher PPK is expected to (i) increase perceived harmfulness of gambling, which reduces gambling frequency; (ii) increase awareness of legal gambling age limits, which reduces gambling frequency; (iii) decrease perceived peer gambling, thereby reducing the likelihood of overestimating peers' involvement, which would otherwise encourage more frequent gambling.

Measures

In this section, we describe our variables and test their internal reliability. The transcripts of the survey questions are reported in Supplementary Table S6.

Perceived parental knowledge (independent variable)

PPK is measured with two items: (i) “Do your parents know where you spend Saturday nights?” rated on a 4-point scale from “usually do not know” to “always know,” and (ii) “My father and/or mother know where/who I am with in the evening,” rated on a 5-point scale from “almost never” to “almost always”. The Cronbach's alpha of this measure is 0.64 (95% CI = 0.63–0.65).

Gambling frequency (dependent variable)

Gambling frequency is measured through the question: “Think back over the last 12 months. On how many occasions have you engaged in gambling on the following types of games?”. The question includes 13 distinct gambling activities explicitly defined in advance as all those games of chance in which money can be won and/or lost, in line with the official definition of gambling as provided by the relevant Italian legislation (art. 721 of the Italian Penal Code) and its scientific definition. For the list of games, see Supplementary Table S6, Panel S6.1. Response options range from (1) “Never” to (6) “6 or more times a week,” broadly paralleling earlier ESPAD Italia measures (Supplementary Table S6, Panel S6.3). The scale has good internal reliability, with Cronbach’s $\alpha = 0.89$ overall (95% CI = 0.89–0.90).

As in Canale et al.¹⁰, these responses are also used for descriptive purposes to categorize respondents into four mutually exclusive groups. The classification combines information on both gambling frequency and the number of gambling activities performed at least monthly, thereby capturing both the intensity and breadth of gambling involvement. Respondents are categorized as: “non-gamblers” (reporting no gambling activity); “occasional gamblers” (reporting no more than “once a month or less” across all activities); “monthly gamblers” (participating in one or two gambling activities at least monthly, i.e., “2–4 times a month” or more); and “frequent gamblers” (participating in more than two gambling activities at least monthly). An alternative classification based exclusively on gambling frequency produced similar descriptive distributions.

Mediating variables

Following the framework described in “The Conceptual Model,” the benchmark specification includes perceived harmfulness of gambling and perceived peer gambling as mediators. As an extension, we introduce adolescents’ awareness of legal gambling age limits as a novel normative pathway (details in “Extensions”).

- *Perception of the Harmfulness of Gambling.* Perceived harmfulness of gambling is assessed using two items referring to different levels of gambling involvement: “How much do you think people risk harming themselves (physically or in other ways) if they gamble less than once a week (item 1) or once a week or more (item 2).” Students answered each question on a 4-point scale ranging from 1 = no risk to 4 = great risk. The Cronbach’s alpha of this measure is 0.78 (95% CI = 0.78–0.79). As a robustness check, we re-estimated the main models using only the item referring to gambling once a week or more (item 2); the results are substantively unchanged and are available upon request.
- *Perceived Descriptive Norms.* Students’ estimations of their friends’ gambling are assessed with a single item, “How many of your friends would you estimate gamble,” measured on a 5-point scale ranging from 1 = none to 5 = all.

Demographic variables

We controlled for adolescents’ demographic and socioeconomic characteristics associated with gambling behavior, including gender, age, perceived relative household income, paternal and maternal educational attainment^{25,39}. We also included regional fixed effects to account for unobserved heterogeneity across schools within different regions.

Extensions

Mediator extension

As a novel normative pathway, we introduce the *Awareness of Legal Gambling Age Limits* variable as a mediator. We construct it using two ESPAD question blocks:

- “Which of the following groups of gambling games do you think are prohibited for minors under 18? Check all that apply.” For the list of games, see Supplementary Table S6, Panel S6.1.
- “In your opinion, online gambling in Italy is prohibited for: minors under 14; minors under 16; minors under 18; not prohibited; don’t know.”

Each game group in (i) is coded 1 if “prohibited to minors under 18” is selected, and the online item in (ii) is coded 1 if “minors under 18” is selected. We create a composite variable with items in the first group ($\alpha = 0.88$, 95% CI = 0.88–0.89), whereas we treat the item on awareness of age limits for online gambling as a standalone measure.

Heterogeneity analyses

We conduct separate analyses by gender and by legal age (below 18 vs. 18 and above), to take account of the fact that for part of our sample, gambling is a legal activity.

Outcome extension

As an extension of the main gambling-frequency framework, we estimate the model using online gambling frequency as the dependent variable. This is measured through a question asking respondents on how many occasions, if any, they participated in online gambling during the past 12 months. The response categories are: (1) “0,” (2) “1–2,” (3) “3–9,” (4) “10–19,” and (5) “20 or more occasions.”

Statistical analyses

Following Canale et al.¹⁰, we conducted the analyses in R using the lavaan package and applied a three-step cross-validation strategy (we also ran a full-sample model for comparison). In the cross-validation procedure, we randomly divided the dataset into three equal partitions, ensuring that each subsample maintained the

representativeness of gender, age, and survey edition. In the first step (Partition 1), we examined the factorial properties of all measures. After confirming the factor structure, we created single-factor scores for each construct using confirmatory factor analysis (CFA) with diagonally weighted least squares when three or more items were available and exploratory factor analysis (EFA) for two-item constructs. Note that we used EFA instead of CFA for two-item constructs to avoid negative error variances.

In the second step, we developed the mediation model using a calibration sample (Partition 2), and in the third step, we validated it in an independent validation sample (Partition 3).

We tested the theoretical model through path analysis with a single factor score per construct. In each model, we clustered the standard errors at the school level and applied survey weights. We used robust maximum likelihood estimation to fit the model. Missing data on both endogenous and exogenous variables were handled using full information maximum likelihood estimation. We evaluated model fit using the R^2 values of endogenous variables.

We examined the factorial properties using polychoric correlations for measures with fewer than three items, and confirmatory factor analysis (CFA) otherwise. For Gambling Frequency, based on the factorial properties obtained from the CFA in the first partition, the fit indices and R^2 values are: $X^2(65) = 1329$, $p < 0.001$, CFI = 0.98, RMSEA = 0.06; R^2 : item 1 = 0.40; item 2 = 0.73; item 3 = 0.74; item 4 = 0.79; item 5 = 0.45; item 6 = 0.60; item 7 = 0.66; item 8 = 0.72; item 9 = 0.69; item 10 = 0.77; item 11 = 0.66; item 12 = 0.58; item 13 = 0.71. The size of the polychoric correlation coefficient for the two items concerning the Perceived Harmfulness of Gambling is 0.80, and for PPK is 0.63. Finally, the fit indices and R^2 values based on the factorial properties obtained from the CFA for the Awareness of Legal Gambling Age Limits are: $X^2(20) = 590$, $p < 0.001$, CFI = 0.99, RMSEA = 0.07; R^2 : item 1 = 0.47; item 2 = 0.81; item 3 = 0.82; item 4 = 0.81; item 5 = 0.75; item 6 = 0.79; item 7 = 0.84; item 8 = 0.74. Overall, the factorial properties closely mirror those reported by Canale et al.¹⁰, supporting the comparability of the core constructs across survey waves.

Data availability

The codes for all statistical analyses are publicly available at <https://osf.io/8aqp5>. The data used in this study derive from the ESPAD[®] Italia study. The data that support the findings of this study are available upon reasonable request to espad@ifc.cnr.it.

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References

- Chen, Y., Gu, Q., Xu, Y., Liang, J. & Ni, C. A chain mediation model reveals the association between parental mediation and smartphone addiction of Chinese adolescents. *Sci. Rep.* **15**, 15777. <https://doi.org/10.1038/s41598-025-00876-9> (2025).
- Donati, M. A., Beccari, C., Sanson, F., Iraci Sarelli, G. & Primi, C. Parental gambling frequency and adolescent gambling: a cross-sectional path model involving adolescents and parents. *PLoS One* **18**, e0280996. <https://doi.org/10.1371/journal.pone.0280996> (2023).
- Guerra, A. & Scorcu, A. E. Parents' vs. friends' influence on teenagers' deception about gambling. *Rev. Econ. Household* **23**, 589–624. <https://doi.org/10.1007/s11150-025-09765-6> (2025).
- Kim, C., Yang, Z. & Lee, H. Parental style, parental practices, and socialization outcomes: an investigation of their linkages in the consumer socialization context. *J. Econ. Psychol.* **49**, 15–33. <https://doi.org/10.1016/j.joep.2015.03.006> (2015).
- Xu, X. & Hanafi, Z. The unique effects of parental control from fathers on self-determination in Chinese middle school adolescents. *Sci. Rep.* **15**, 14580. <https://doi.org/10.1038/s41598-025-97925-0> (2025).
- Barnes, G. M., Hoffman, J. H., Welte, J. W., Farrell, M. P. & Dintcheff, B. A. Effects of parental monitoring and peer deviance on substance use and delinquency. *Journal of Marriage and Family* **68**, 1084–1104. <https://doi.org/10.1111/j.1741-3737.2006.00315.x> (2006).
- Morleo, M., Cook, P. A., Elliott, G. & Phillips-Howard, P. A. Parental knowledge of alcohol consumption: a cross sectional survey of 11–17 year old schoolchildren and their parents. *BMC Public Health* **13**, 412. <https://doi.org/10.1186/1471-2458-13-412> (2013).
- Branstetter, S. A. & Furman, W. Buffering effect of parental monitoring knowledge and parent-adolescent relationships on consequences of adolescent substance use. *J. Child Fam. Stud.* **22**, 192–198. <https://doi.org/10.1007/s10826-012-9568-2> (2013).
- Carroll, H. A. et al. Effects of parental monitoring on alcohol use in the US and Sweden: A brief report. *Addict. Behav.* **63**, 89–92. <https://doi.org/10.1016/j.addbeh.2016.07.014> (2016).
- Canale, N. et al. Adolescent gambling-oriented attitudes mediate the relationship between perceived parental knowledge and adolescent gambling: Implications for prevention. *Prev. Sci.* **17**, 970–980. <https://doi.org/10.1007/s11121-016-0683-y> (2016).
- Lombardi, G. et al. The cards they're dealt: types of gambling activity, online gambling, and risk of problem gambling in European adolescents. *Soc. Sci. Med.* **363**, 117482. <https://doi.org/10.1016/j.socscimed.2024.117482> (2024).
- Cooper, K. et al. Loneliness, social relationships, and mental health in adolescents during the COVID-19 pandemic. *J. Affect. Disord.* **289**, 98–104. <https://doi.org/10.1016/j.jad.2021.04.016> (2021).
- Hamatani, S., Hiraoka, D., Makita, K., Tomoda, A. & Mizuno, Y. Longitudinal impact of COVID-19 pandemic on mental health of children in the ABCD study cohort. *Sci. Rep.* **12**, 19601. <https://doi.org/10.1038/s41598-022-22694-z> (2022).
- Palacios-Ceña, D. et al. Substance use in Spanish adolescent gamblers before and after the COVID-19 pandemic state of alarm: a population-based study. *Sci. Rep.* **15**, 30278. <https://doi.org/10.1038/s41598-025-16121-2> (2025).
- Biagioni, S., Fizzarotti, C. & Molinaro, S. *Sotto la superficie: Le nuove sfide dell'adolescenza tra rischi e quotidianità. Rapporto di ricerca sulla diffusione dei comportamenti a rischio fra gli studenti delle scuole superiori di secondo grado* Consiglio Nazionale delle Ricerche, Istituto di Fisiologia Clinica, (2025). https://www.epid.ifc.cnr.it/wp-content/uploads/2025/09/ESPAD_2024_Final-compresso.pdf
- Colasante, E. et al. Problematic gaming risk among European adolescents: a cross-national evaluation of individual and socio-economic factors. *Addiction* **117**, 2273–2282. <https://doi.org/10.1111/add.15843> (2022).
- ESPAD Group. *Key findings from the 2024 European School Survey Project on Alcohol and Other Drugs (ESPAD)*. Eur. Union Drugs Agency, (2025). https://www.euda.europa.eu/publications/data-factsheets/espad-2024-key-findings_en
- Mosconi, G. et al. Gaming and gambling behaviours among Italian adolescents: a cross-sectional study. *Lancet Public Health* **11**, e8–e16. [https://doi.org/10.1016/S2468-2667\(25\)00274-9](https://doi.org/10.1016/S2468-2667(25)00274-9) (2026).
- Tran, L. T. et al. The prevalence of gambling and problematic gambling: a systematic review and meta-analysis. *Lancet Public Health* **9**, e594–e613. [https://doi.org/10.1016/S2468-2667\(24\)00126-9](https://doi.org/10.1016/S2468-2667(24)00126-9) (2024).

20. Italian Chamber of Deputies. Relazione sul settore dei giochi pubblici (Anno 2025). Parliamentary Document CCXLVI, no. 1, XIX Legislature. Ministry of Economy and Finance, (2026). https://documenti.camera.it/_dati/leg19/lavori/documentiparlamentari/IndiceTesti/246/001/INTERO.pdf
21. Benedetti, E., Lachi, A., Lombardi, G. & Molinaro, S. From policy to practice: Assessing the impact of electronic gambling machine regulations on harmful gambling behaviour. *J. Epidemiol. Community Health* **79**, 726–732. <https://doi.org/10.1136/jech-2024-222474> (2025).
22. Gastaldi, F. *La fiscalità nel settore dei giochi*. Focus no. 6 Ufficio parlamentare di bilancio, (2018). https://www.upbilancio.it/wp-content/uploads/2018/05/Focus_6_2018.pdf
23. Papineau, E. et al. Assessing the differential impacts of online, mixed, and offline gambling. *Int. Gambl. Stud.* **18**, 69–91. <https://doi.org/10.1080/14459795.2017.1378362> (2018).
24. Guerra, A., Randon, E. & Scorcu, A. E. Gender and deception: evidence from survey data among adolescent gamblers. *Kyklos* **75**, 618–645. <https://doi.org/10.1111/kykl.12305> (2022).
25. Latvala, T., Lintonen, T., Luopa, P. & Raisamo, S. Gambling among Finnish 14–16-year-old adolescents before (2008–2009), during (2010–2011), and after (2013–2017) setting the legal age limit of 18 for gambling and the role of socio-economic status. *J. Gambl. Stud.* **38**, 1243–1256. <https://doi.org/10.1007/s10899-021-10091-6> (2022).
26. Livazović, G. & Bojčić, K. Problem gambling in adolescents: what are the psychological, social and financial consequences? *BMC Psychiatry*. **19**, 308. <https://doi.org/10.1186/s12888-019-2293-2> (2019).
27. Crouter, A. C. & Head, M. R. Parental monitoring and knowledge of children. In *Handbook of Parenting: Vol. 3. Being and Becoming a Parent* (ed Bornstein, M. H.) 461–483 (Erlbaum, 2002).
28. Parrado-González, A., Fernández-Calderón, F., Newall, P. W. S. & León-Jariego, J. C. Peer and parental social norms as determinants of gambling initiation: a prospective study. *J. Adolesc. Health*. **73**, 296–301. <https://doi.org/10.1016/j.jadohealth.2023.02.033> (2023).
29. Bandura, A. *Social learning theory* (Prentice-Hill, 1977).
30. Mancone, S., Zanon, A., Marotta, G., Celia, G. & Diotaiuti, P. Temporal perspectives, sensation-seeking, and cognitive distortions as predictors of adolescent gambling behavior: a study in Italian high schools. *Front. Psychiatry*. **16**, 1602316. <https://doi.org/10.3389/fpsyt.2025.1602316> (2025).
31. Wardle, H. et al. The Lancet Public Health Commission on gambling. *Lancet Public Health*. [https://doi.org/10.1016/S2468-2667\(24\)00167-1](https://doi.org/10.1016/S2468-2667(24)00167-1) (2024).
32. Dowling, N. A. et al. Early risk and protective factors for problem gambling: a systematic review and meta-analysis of longitudinal studies. *Clin. Psychol. Rev.* **51**, 109–124. <https://doi.org/10.1016/j.cpr.2016.10.008> (2017).
33. Newton, N. C. et al. A systematic review of combined student- and parent-based programs to prevent alcohol and other drug use among adolescents. *Drug Alcohol Rev.* **36**, 337–351. <https://doi.org/10.1111/dar.12497> (2017).
34. De Los Reyes, A., Goodman, K. L., Kliewer, W. & Reid-Quinones, K. The longitudinal consistency of mother-child reporting discrepancies of parental monitoring and their ability to predict child delinquent behaviors two years later. *J. Youth Adolesc.* **39**, 1417–1430. <https://doi.org/10.1007/s10964-009-9496-7> (2009).
35. Caudwell, K. M., Casanova, A. F. & Flack, M. How does problem gambling impact the relationship between gambling attitudes and frequency? *J. Gambl. Stud.* **41**, 1163–1174. <https://doi.org/10.1007/s10899-025-10379-x> (2025).
36. Kesaite, V., Wardle, H. & Rossow, I. Gambling consumption and harm: a systematic review of the evidence. *Addict. Res. Theory*. **32**, 194–203. <https://doi.org/10.1080/16066359.2023.2238608> (2023).
37. Moore, E., Pryce, R., Squires, H. & Goyder, E. The association between gambling frequency and risk of harm: analysis using health survey data from England and Scotland. *Addiction* **121**, 1337–1625. <https://doi.org/10.1111/add.70344> (2026).
38. Testa, G. et al. Cross-jurisdictional factors linked to gambling frequency in adolescents from 28 European countries: a machine learning approach. *Psychiatry Res.* **351**, 116602. <https://doi.org/10.1016/j.psychres.2025.116602> (2025).
39. Auger, N., Lo, E., Cantinotti, M. & O'Loughlin, J. Impulsivity and socio-economic status interact to increase the risk of gambling onset among youth. *Addiction* **105**, 2176–2183. <https://doi.org/10.1111/j.1360-0443.2010.03100.x> (2010).

Author contributions

A.G., S.T.E., S.M., and E.B. conceived and designed the study. R.C. collected the data. A.G. and S.T.E. developed the methodology, and S.T.E. performed the statistical analyses. A.G., S.T.E., S.M., R.C., and E.B. wrote the manuscript. A.G., S.T.E., R.C., and E.B. reviewed and edited the manuscript. All authors read and approved the final manuscript.

Declarations

Competing interests

The authors declare no competing interests.

Ethical approval

The study complies with European and national ethical guidelines and received ethical approval (No. 0027159/2019) from the Research Ethics and Integrity Committee of the Italian National Research Council.

Informed Consent

Passive parental consent was used, with information letters provided to schools, parents or guardians, teachers, and students outlining the study's aims, administration procedures, privacy and anonymity safeguards, and all the necessary information about the study. Participation was entirely voluntary, and students could withdraw at any time without consequence. All data were collected anonymously, and strict measures were taken to protect privacy.

Additional information

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1038/s41598-026-57703-y>.

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