



# Loot box purchases and their relationship with internet gaming disorder and online gambling disorder in adolescents: A prospective study

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## ABSTRACT

In recent years, the video game industry has introduced Loot Box (LB), a new type of microtransaction in which a gamer uses real currency to purchase a random virtual item within a video game. Recently, LBs became more widespread and there is evidence suggesting their similarity to online gambling. Although some studies have investigated the association between LBs with disordered gaming and disordered gambling, very few have done so with clinical indicators of these problems. Furthermore, to the best of our knowledge no longitudinal evidence of such relationships currently exists in the literature. Therefore, the present study aimed to 1) ascertain the stability of LB purchasing in minors and 2) investigate the associations between LB purchasing with gambling online and online gambling disorder within six months. A prospective cohort study was conducted at two time points six months apart. In total, 2,213 Spanish adolescents (1,067 [48.9%] boys) aged between 11 and 17 years participated in both waves. The purchase of LBs was prevalent and stable in the sample across the six months. While a positive relationship was found between purchasing LBs and online gambling six months later, the relationships between purchasing LBs and the presentation of online gambling disorder and gaming disorder require further study.

## 1. Introduction

Playing video games is a common leisure activity performed by almost one in two individuals worldwide. The latest data on video game consumption suggests that almost 2.7 billion users played in 2020, with this figure potentially reaching approximately 3 billion individuals by the end of 2022 (Wijman, 2020). For years, the video game industry allowed players to pay a certain price for a specific advantage or item within a video game, such as a skin (i.e., an item that modifies the appearance of an avatar). These purchases are acquired through so-called microtransactions, which are embedded in numerous games (King & Delfabbro, 2019), and are a common way for the video game industry to increase their annual revenue.

Lately, legal, social, scientific, and clinical concerns have arisen about a specific type of microtransaction called Loot Boxes (LBs; although they can be found under other names, such as crates, gachas, and chests). LBs can be purchased within video games using money

(either real or virtual money that has previously been legal tender). Unlike a microtransaction, in which a certain amount of money is paid for a known object, a LB is typically a random purchase—the person does not know what they will get beforehand and the probability with which a given reward appears is often unknown to the player) (Drummond, Sauer, Hall et al., 2020; Montiel et al., 2022; Zendle & Cairns, 2018). Notably, the most desired objects provided by LBs have significantly lower chances of appearing, although the probability of these items being presented is typically not known (Gong & Rodda, 2020). This, in turn, may lead to potential risks, the excessive use of LBs and/or other risky LB-related behaviors (Larche et al., 2019) owing to the user's relationship with the reward systems present in online gambling. (González-Cabrera et al., 2022; von Meduna et al., 2020; Xiao, 2020).

Recently, the debate about whether LBs should be conceptualized as a type of online betting has been widespread. Although there is a general consensus in the scientific community on this issue, its nuances remain a matter of debate. There are broad perspectives, such as that of

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Drummond, Sauer, Hall et al., (2020), suggesting that virtual items have real-world monetary value to users regardless of whether they can be cashed out and, therefore, could be regulated within the scope of the current gambling legislation. More restrictively, other authors pointed out that this association occurs when a random virtual object is purchased with money (real and/or in-game, which has previously been exchanged for legal tender) (González-Cabrera et al., 2022; von Meduna et al., 2020; Xiao, 2020). The conceptualization of this phenomenon also affects how governments regulate LBs (Montiel et al., 2022; Xiao et al., 2022). For example, in 2018, Belgium and the Netherlands recalled video games containing LBs from the market for minors (Zendle & Cairns, 2019). Additionally, some states in the United States have banned the sale of games containing LBs to minors (Wong, 2019), while Japan has prohibited games with specific types of LBs (e.g., the kompu gacha) (McCaffrey, 2019).

The purchase of LBs can have implications for people at all developmental stages. However, based on the assumption that LBs constitute a form of covert gambling that can be linked to online gambling, minors (who cannot legally gamble) constitute a population that requires additional safeguards (Gibson et al., 2022) as children appear to be more vulnerable to developing problematic use of digital media, particularly when they present other comorbidities (Thorell et al., 2022). According to a systematic review by Montiel et al. (2022), the prevalence of LB purchasing among adolescent video game players varied between 20% and 33.9% in the past year, further suggesting that this behavior is common practice among minors. In other studies, with mixed samples of minors and adults, the proportion has been reported to be even higher—between 12.1% and 46.2%. However, caution should be exercised when interpreting these data as studies usually differ in terms of methodology, the definition of LBs, and the representativeness of the sample, among other aspects (Montiel et al., 2022; Spicer et al., 2021). In general, it has been reported across several studies that boys tend to purchase more LBs than girls (DeCamp, 2021; González-Cabrera et al., 2022; Wardle & Zendle, 2021).

Despite the aforementioned discrepancies in prevalence rates and definitions, a consensus appears to be in place regarding the association between LBs and online gambling problems (Drummond, Sauer, Hall, et al., 2020; Drummond, Sauer, Ferguson et al., 2020; Gibson et al., 2022; González-Cabrera et al., 2022; Montiel et al., 2022; Spicer et al., 2021; Zendle & Cairns, 2019). Several authors, along with others such as Delfabbro and King (2020), have suggested that LBs may introduce covert gambling within video games and act as a gateway to problem gambling (Spicer et al., 2022). Relatedly, a small but potentially relevant clinical association has been found between the symptomatology of pathological gambling and spending on LBs (Garea et al., 2021). Close et al. (2022) pointed out that buyers of LBs were more likely to gamble than people who performed other in-game microtransactions and that younger people consumed more LBs.

More recently, a systematic review study investigating the relationship between microtransactions and disordered gaming and disordered gambling suggested a positive association between these variables, with LBs posing a greater risk for addiction than other types of microtransactions and greater in-game expenditure being associated with a higher risk of disordered gambling (Raneri et al., 2022). Still, very few studies have linked the purchase of LBs and online gambling disorder and the longitudinal relationship between these problems is still unknown, particularly in minors (Montiel et al., 2021). Similarly to the purchase of LBs, numerous studies have suggested that boys are more likely than girls to gamble online and have greater gambling-related problems (Andrie et al., 2019; Aricak, 2019; González-Cabrera et al., 2020; Montiel et al., 2021).

The association between buying LBs and problems with gaming has also been discussed; however, most studies to date have related the two problems cross-sectionally (Montiel et al., 2022), limiting our understanding of the extent to which such findings may occur over time. Nevertheless, there have been studies in which no association (King

et al., 2020) has been found and/or the results have indicated no support for this relationship (von Meduna et al., 2020). Most of this research has been limited to samples of adults and the phenomenon in underage individuals is still not well understood (Montiel et al., 2022; Raneri et al., 2022).

In order to shed light on this issue, many authors have stressed the importance of conducting longitudinal studies to examine the potential relationships between the purchase of LBs and online gambling and disordered gambling (Garea et al., 2021; Gibson et al., 2022; Montiel et al., 2022). While Brooks and Clark (2022) recently reported the first association over time between the purchase of LBs and gambling in adults, there currently appears to be no evidence of such a relationship over time in minors.

In light of the aforementioned rationale, the objectives of this study were twofold: 1) to ascertain the stability of LB purchasing among minors and 2) to investigate the associations between the purchase of LBs and gambling online, online gambling disorder (OGD) and Internet Gaming Disorder (IGD) within six months. Specifically, this study sought to answer the following research questions: 1) What is the prevalence of the purchase of LBs across two time points within six months? 2) Does purchasing LBs increase the risk of gambling online six months later? 3) Does purchasing LBs increase the risk of OGD and IGD six months later?

## 2. Method

### 2.1. Design and participants

A prospective cohort study was conducted at two time points with an interval of six months (December 2020 and May 2021). The initial sample consisted of 2,817 participants from seven schools in the province of Valencia (Spain) (three public schools, three private schools, and one concerted school). Due to incomplete questionnaires or association problems between the two waves, the final sample consisted of 2,213 participants (participation rate: 78.5%). The sample was representative of the reference population with a 99% Confidence Interval (CI) and a 3% margin of error. In the final sample, there were 1,067 males (48.9%) with the mean age of the total sample being  $13.89 \pm 1.46$  at Time 1 (T1) and  $14.20 \pm 1.50$  at Time 2 (T2), with a range of 11–17 years (according to current Spanish legislation people under 18 are not allowed to gamble). There were 29 students from 6th grade of Primary Education (1.3%), 1,926 of Compulsory Secondary Education (88.4%), 183 of High school (8.4%), and 45 of Basic Vocational Training (2.1%) and 30 participants did not respond to this question.

### 2.2. Measures

Sociodemographic data was collected from all participants. These included the following questions: “Have you bought a Loot Box in any video game in the last 12 months with real money or in-game money (which had previously been legal tender)?”. This item allowed us to select the group of exposed (i.e., buyers) and unexposed (i.e., non-buyers) individuals at T1. The same question was posed for T2 but addressing the last six months. The response to this item was dichotomous (i.e., Yes/No). In addition, the exposed youths were asked: “How many times have you opened a Loot Box in the last week?”, “How many times have you purchased a Loot Box in the last week?” (both questions had the following ordinal scale: none, 1–5 times, 6–10 times, 11–30 times, 31–50 times or + 50 times). It was also asked “How much money have you invested/spent on Loot Boxes in the last month?” (the ordinal response scale was: none, 1–10€, 11–25€, 26–50€, 51–100€ or +100€). Lastly, “Have you bet online in the last 12 months in any kind of game (bingo, poker, sports betting, etc.)?”, and “Have you played video games in the last 12 months?”. The response to these last two items was dichotomous (i.e., Yes/No).

Furthermore, IGD was assessed with the Spanish version of the Internet Gaming Disorder Scale–Short-Form (IGD9-SF) (Beranuy et al., 2020; Pontes et al., 2014; Pontes & Griffiths, 2015). This scale consists of

nine items based on the *Diagnostic and Statistical Manual of Mental Disorders* 5th edition (DSM-5) criteria for IGD (e.g., “Have you deceived any of your family, therapists, or friends about the time you spend gaming?”) (American Psychiatric Association, 2013). The scale response options range from 0 (never) to 4 (very often). A participant is considered to meet a clinical diagnosis of IGD when their response choices are often or very often on at least five of the nine items (Beranuy et al., 2020; Pontes et al., 2014; Pontes & Griffiths, 2015). The total score ranges between 0 and 36. Cronbach’s alpha coefficients for this sample were .79 and .85, for T1 and T2 respectively and the McDonald’s Omega were 0.80 and 0.87 for T1 and T2 respectively.

As for OGD, this construct was evaluated with the Online Gambling Disorder Questionnaire (OGD-Q) (González-Cabrera et al., 2020). This scale consists of 11 items that assess OGD in adolescence. (e.g., “Do you feel nervous, irritated, or angry when trying to reduce or stop gambling online?”). The scale response options range from 0 (never) to 4 (every day). A participant is considered to meet a clinical diagnosis for OGD when their response options are frequently, almost every day, or every day on at least four of the items (González-Cabrera et al., 2020). The total score ranges between 0 and 45. Cronbach’s alpha coefficients for this sample were .91 and .96, for T1 and T2 respectively and the McDonald’s Omega were 0.91 and 0.96 for T1 and T2 respectively.

2.3. Procedure

The sample was recruited through an online survey using SurveyMonkey©. Participants completed the online survey in their classrooms using mobile devices or a computer in the classrooms with the guidance and supervision of a classroom tutor. The time needed to fill out the survey ranged between 5 and 10 min depending on students’ age and reading comprehension. All participants provided an anonymized ID that was formed by combining the initials of their maternal and paternal grandparents’ names. This anonymous ID was requested in both waves and the questionnaires were linked. Consents were sent to the families of students through school’s communication channels (1% declined to participate). This study was approved by the Research Ethics Committee of the Universidad Internacional de la Rioja (UNIR). There were no exclusion criteria, except for the refusal to participate by the legal guardians and/or the students themselves.

2.4. Data analysis

The statistical analyses were performed with the Statistical Package for the Social Sciences (SPSS) v.25 (IBM Corp, 2017) and EPIDAT 3.1 (Xunta de Galicia, 2006) program.

To investigate the study’s objectives, the following statistical analyses were carried out: (a) Cronbach’s alpha and McDonald’s Omega for internal consistency; (b) central tendency and dispersion, and frequency analysis; (c) point and over time prevalences; (d) sign test; (e) Pearson’s Rho bivariate correlation and (f) variance of analysis with post hoc Games-Howell comparisons (Eta<sup>2</sup> was calculated to determine the effect size). In order to investigate the relationship between the study variables from an epidemiological approach to the problem, the following analyses were performed: Prevalence Ratios (PR) and Relative Risks (RR) with 95% CI. A p-value of less than 0.05 was considered as statistically significant. The sex variable was taken into account for multiple variables.

3. Results

3.1. Prevalence of the purchase of LBs and associated sociodemographic variables

Of the total sample (n = 2.213), 1.989 adolescents (91.2%) had played video games in the past 12 months. In this group, 559 minors (25.3%) had purchased LBs at T1, and the prevalence at T2 was 27.3%

(n = 604). Of the entire sample, there were 726 participants (32.8%) who purchased LBs at T1 and/or T2 (this was the prevalence over time during the six months of study). Among those who bought LBs at any point, 130 (17.9%) did so only at T1, 188 (25.9%) did so only at T2, and 408 (56.2%) did so at both waves. The correlation between purchasing LBs at T1 and purchasing at T2 was r = 0.60 [CI 95% 0.57–0.63].

Table 1 shows how many times participants had purchased LBs in the past week and how much money they had spent in the past month at T1 and T2. Of these, 40.4% had opened LBs in the past week at T1 and 47.7% at T2; there was no significant increase at T2 compared with T1, either in opened boxes (p = .227) or in money invested in the past month (p = .393). However, there was a significant increase in the range of LB purchases at T2 compared to T1 (Z = -2.46, p = .013).

3.2. Relationship between buying LBs, gambling online, and online gambling disorder

At T1, there were 235 minors (10.6%; 149 boys and 86 girls) who had gambled online in the last 12 months. At T2, this number was 246 (11.1%; 145 boys, 98 girls, and 3 adolescents who did not report their sex). At T1, 14 participants presented a diagnosis of OGD (0.6% of the total sample and 6% of the sample who had gambled). At T2, 25 participants presented OGD (1.1% of the total sample and 10.2% of the sample who had gambled; 16 boys and 9 girls).

In relation to the association between purchasing LBs and online gambling (in general), the Prevalence Ratio (PR) at T1 (n = 1.988) was 2.87 [CI 95% 2.26–3.67]. When the variable sex was taken into account, boys (n = 1.053) had a PR of 2.67 [CI 95% 1.92–3.72] and girls (n = 935) had a PR of 3.32 [CI 95% 2.02–5.46]. Moreover, at T2 (n = 1.889), the PR was 2.55 [CI 95% 2.02–3.23]; when sex was accounted for, boys (n = 1.016) had a PR of 2.59 [CI 95% 1.83–3.64] and girls (n = 873) had

Table 1

Loot boxes purchased last week and money invested/spent in the past month at Time 1 (T1) and Time 2 (T2) and comparison between times.

Sociodemographic question	Response category	Sample T1 f (%)	Sample T2 f (%)	Sign test (p)
How many times have you opened a Loot Box in the past week? (n = 359)	None	297 (59.6)	310 (52.3)	Differences - (90)
	1-5 times	90 (18.1)	181 (30.5)	Differences + (108)
	6-10 times	69 (13.9)	53 (8.9)	Ties (161)
	11-30 times	30 (6)	29 (4.94)	Z = -1.21 (p = .227)
	31-50 times	8 (1.6)	12 (2)	
How many times have you purchased Loot Boxes in the past week? (n = 344)	+50 times	4 (0.8)	8 (1.3)	
	None	391 (82.1)	453 (75.4)	Differences - (34)
	1-5 times	46 (9.7)	103 (17.1)	Differences + (64)
	6-10 times	27 (5.7)	19 (3.2)	Ties (242)
	11-30 times	6 (1.3)	12 (2.0)	Z = -2.46 (p = .013)
How much money have you invested/spent on Loot Boxes in the past month? (n = 363)	31-50 times	4 (0.8)	7 (1.2)	
	+50 times	2 (0.4)	7 (1.2)	
	None	265 (53.5)	347 (58.4)	Differences - (105)
	1-10€	58 (11.7)	113 (19)	Differences + (92)
	11-25€	82 (16.6)	57 (9.6)	Ties (166)
	26-50€	44 (8.9)	36 (6.1)	Z = -.86 (p = .393)
	51-100€	15 (3)	15 (2.5)	
	+100€	31 (6.3)	26 (4.4)	

Note: f = frequency; % = percentage; p = significance; T1 = Time 1; T2 = Time 2. Differences + = positive differences (T2 > T1); Differences - = negative differences (T1 > T2).

a PR of 3.06 [CI 95% 2.05–4.58]. In other words, online gambling was 2.67 times more prevalent among boys who bought LBs at T1 than among boys who did not buy LBs at T1. Regarding the association between buying LBs at T1 and gambling online at T2, the Relative Risk (RR) for the whole sample ( $n = 1.955$ ) was 2.28 [CI 95% 1.80–2.89]. Boys had a RR of 1.96 [CI 95% 1.43–2.70] and girls had a RR of 3.59 [CI 95% 2.31–5.56]. In other words, boys who had previously purchased LBs presented almost twice the risk of gambling online at six months than those who had not previously purchased LBs (and this risk increased to 3.5 times among girls).

Participants who purchased LBs at T1 presented a RR of 4.00 [ $n = 226$ ; CI 95% 1.53–10.41] of having a clinical problem of online gambling (OGD) at T2. However, when sex was taken into account, boys who purchased LBs at T1 presented a RR of 2.32 [ $n = 139$ ; CI 95% 0.68–7.83] of having a clinical problem of online gambling at T2, but this relationship was not statistically significant. On the contrary, girls who purchased LBs at T1 presented a RR of 10.74 [ $n = 87$ ; CI 95% 2.35–48.96] of having a clinical problem of online gambling at T2; that is, girls who bought LBs exhibited 10 times more risk of presenting clinical problems of online gambling six months later than girls who did not buy LBs.

Table 2 illustrates these findings and displays the differences in levels of IGD as a function of the time at which LBs were purchased. If participants purchased LBs at both T1 and T2, they showed significantly higher levels of IGD ( $p < .001$ ) compared to those who purchased LBs at T1 and not at T2 and those who did not purchase LBs at T1 or T2. There were no significant differences among those who did not buy LBs at T1 but did buy at T2 or for those who purchased both at T1 and T2 ( $p = .994$ ).

### 3.3. Relationship between buying LBs and IGD

Among the total sample ( $n = 2.213$ ), at T1 there were 1.989 minors (91.2%) who had played video games in the past 12 months. At T2 this number was 1.921 (88%). At T1, 34 participants (1.5% of the total

**Table 2**  
Differences in total score in IGD9-SF and OGD-Q in T2 depending on the time of LB purchase.

Problem	LB Purchase (n)	Mean (±SD)	F ( $p <$ )/ $\eta^2$ (Post hoc G-H)
Total score in Spanish version of the Internet Gaming Disorder Scale-Short-Form (IGD9-SF) (n = 1809)	T1(YES)-T2 (NO) <sup>a</sup> (n = 130)	4.59 ± 5.00	$F_{(3,1808)} = 27.43$ ( $p < .001$ ) $\eta^2 = .045$ $c > a, b; d > a, b$
	T1(NO)-T2 (NO) <sup>b</sup> (n = 1085)	3.96 ± 4.79	
	T1(YES)-T2 (YES) <sup>c</sup> (n = 407)	6.70 ± 6.03	
	T1(NO)-T2 (YES) <sup>d</sup> (n = 187)	6.51 ± 6.54	
Total Score in Online Gambling Disorder Questionnaire (OGD-Q) (n = 222)	T1(YES)-T2 (NO) <sup>a</sup> (n = 14)	0.71 ± 1.27	$F_{(3,218)} = 6.99$ ( $p < .001$ ) $\eta^2 = .100$ $c > a, b$
	T1(NO)-T2 (NO) <sup>b</sup> (n = 85)	1.58 ± 4.03	
	T1(YES)-T2 (YES) <sup>c</sup> (n = 91)	6.57 ± 10.29	
	T1(NO)-T2 (YES) <sup>d</sup> (n = 32)	4.53 ± 8.42	

Note:  $f$  = frequency; % = percentage;  $p$  = significance; T1 = Time 1; T2 = Time 2; YES = Purchased in the last 12 months (T1) or 6 months (T2); NO = Not purchased in the last 12 months (T1) or 6 months (T2);  $F$  = Fisher's F;  $\eta^2$  = eta squared; post hoc: Games-Howell post hoc test.

sample and 1.7% of the sample considered gamers) presented IGD. At T2, 35 participants (1.6% of the total sample and 1.8% of the gamers; 20 boys and 15 girls) presented IGD. In total, there were 16 participants (10 boys and 6 girls; 0.8% of video game players) with IGD at T1 and T2.

Participants who purchased LBs at T1 presented a RR of 1.46 [CI 95% 0.73–2.88] of having a clinical problem with video games six months later (at T2). When the variable sex was included in the analysis, boys who purchased LBs at T1 presented a RR of 0.60 [ $n = 1012$ ; CI 95% 0.24–1.50] of having clinical problems with video games six months later (at T2). In this case, there was no statistically significant association between the two problems over time. However, among girls who bought LBs at T1, this RR was 8.91 [ $n = 799$ ; 95% CI 3.20–24.88], meaning that girls who previously purchased LBs exhibited eight times the risk of presenting clinical gaming problems compared to those who did not previously purchase LBs.

Table 2 also displays the differences in the total online gambling disorder scores as a function of when LBs were purchased. Participants who purchased LBs at T1 and T2 had significantly higher levels of online gambling disorder than those who purchased LBs at T1 and not at T2 and those who did not purchase LBs at either T1 or T2 ( $p < .001$ ). Furthermore, there was no significant differences in levels of online gambling disorder with those who did not buy at T1 but did buy at T2 ( $p = .685$ ).

## 4. Discussion

The purchase of LBs constitutes a risky behavior because as it presents with random reward mechanisms (Larche et al., 2019), which are known to increase the risk of addiction. The present study contributes to the understanding of this phenomenon by analyzing the stability of LB purchases in adolescents over a six-month period and examining its association with clinical problems of gambling and gaming. Furthermore, the study has been carried out on a sample of minors (those under 18 years of age), which represents a less studied sample comprised of individuals who, in most countries, would not be allowed to gamble. This helps to fill a gap in the current literature that has been highlighted by several recent reviews (Garea et al., 2021; Gibson et al., 2022; Montiel et al., 2022; Spicer et al., 2021).

The first objective of this study was to determine the stability of LB purchasing behaviors among minors. Based on the findings obtained, of all the minors who bought LBs at T1, almost one in five had done so in the previous week and more than 56% of the sample of LB buyers continued to do so six months later. These data may suggest that purchasing LBs is a relatively stable behavior over time. Additionally, there was evidence that more minors bought LBs at T2 than at T1. Likewise, the prevalence rates of LB purchases in the past 12 months at the two time points (25.3% at T1 and 27.3% at T2) were in the range found in other previous studies among adolescent gamers, which varied between 20% and 33.9% (Montiel et al., 2022; González-Cabrera et al., (2022)). These findings answer the first question by showing the stability over time between the two waves. These results are in the same range as those seen in previous studies in Spain with large samples of minors (e.g., González-Cabrera et al., (2022)) and lower than those seen in other pilot studies, such as that of Sanmartín et al. (2021), which presented a very limited sample of adolescent gamers and should be considered tentatively.

In addition, it should be noted that minors purchased significantly more LBs in the previous week at T2 than at T1 (although no differences in spending in the past month were found between T1 and T2). This is of interest, as a recent study examined the relationship between LB purchasing and problem gambling among adolescents (aged 12–17) while controlling for monetary expenditure, age, and gender (Hing et al., 2022). In the present study, over the course of the six months, the types of video game played (and thus the types of LBs purchased) may also have changed. In this regard, (Zende and Cairns, 2019) suggested that the relationship between LB spending and problem gambling is not due to a general deregulation in gambling expenditure among problem

gamblers but, rather, has to do with the specific characteristics of the LBs in each given game.

In relation to the second objective of the present study, which was to examine the association between LB purchasing and online gambling at six months, the results provide a unique contribution to the field. The main results suggest that boys who bought LBs at T1 presented almost twice the risk of gambling online at six months compared to those who did not buy LBs at T1. This same risk appeared 3.5 fold for girls. At present, research on this issue is scarce, with only a few cross-sectional studies conducted primarily among adolescents showing a relationship between the two phenomena (DeCamp, 2021; Ide et al., 2021; Kristiansen & Severin, 2020), although there have been studies with mixed samples of adolescents and adults (González-Cabrera et al., 2022; Macey & Hamari, 2019; Wardle & Zendle, 2021). Some studies have even found no relationship (Gentles et al., 2022). Cross-sectional studies with only adult populations are more abundant (Montiel et al., 2022). In any case, almost all of them have shown some kind of relationship between the two problems. In this sense, these data illustrate a relationship over time between these two issues and constitutes an interesting contribution to the field of study that will require further research. This was an attempt to answer the second research question.

Regarding the relationship between buying LBs at T1 and presenting online gambling disorder six months later at T2, the results should be interpreted with particular caution. Although the initial study includes a large and representative sample of a Spanish region, the final number of adolescents that can be classified with online gambling disorder is low and this can lead to limitations at the statistical level. However, these prevalence data are within the same range as data from the most recent studies reporting the prevalence of clinical gambling problems in minors below 1% (Andrade et al., 2021; González-Cabrera et al., 2020). With that said, although this global prevalence is low, there is a greater number of adolescents who play online and could develop clinical problems (Andrade et al., 2021; González-Cabrera et al., 2020).

Although the present study found no association between buying LBs at T1 and presenting online gambling disorder six months later among the male sample, the results for the female sample should be treated with caution until further studies are conducted. However, there is evidence, such as that found by Kristiansen and Severin (2020) pointing toward a stronger association between the purchase of LBs and pathological gambling in girls (versus boys). The reason for this may be that females, in general, are less engaged in LB-related activities than males and may, therefore, be more determined to succeed in video games. Another possible explanation may be related to the acceleration phenomena that have been observed in other addictive behaviors among females (Grant et al., 2012; Zakiniaez et al., 2017).

Regarding the association between buying LBs and presenting clinical problems with video games at six months, the results suggest that there is no statistically significant over time relationship between the two problems for boys, but there is for girls; this answers the third question of the study. Previous studies have suggested that the risk of IGD is higher among males than among females (Dong et al., 2018; López-Fernández et al., 2020). In this sense, this study asks broadly about the purchase of LBs, which can be found across a wide variety of game profiles, interests, and platforms.

According to the most recent report published by the Spanish Association of Video Games (Asociación Española de Videojuegos, 2021), the consumption of video games is similar between boys and girls in the 11-to-14-year-old age range (4%), but among those aged 15–24 years, it is slightly higher for boys (11%) than for girls (9%). This indicates a trend of relatively similar use between boys and girls at these ages. In addition, smartphone is the most used gaming device across both sexes. In relation to this, (Zendle et al., 2020) pointed out that almost 60% of video games in Google Play and App Store contain LBs and most are suitable from the age of 12.

The results of this study provide a clinical perspective that should also be extrapolated with caution; further research will be necessary to

address whether the different preferences in game types (Huang et al., 2018) (Huang et al., 2017), different motivations to play, or gender differences in terms of competitiveness and socio-emotional inclination (Király et al., 2015) could explain these results. In any case, the number of girls who play video games is gradually rising and it is possible that in the coming years, this will cause an increase among girls in gaming-related problems that have been traditionally associated with boys.

It should also be noted that the sample in this study (adolescents mostly aged 13–16 years) are part of a different generation (Generation Alpha, those born between 2010 and 2024) from the one that has been mostly explored in other studies (Generation Z, those born between the late 1990s and the early years of the 21st century) (McCrindle, 2021). This may also suggest that we are facing a change in trends and that girls present a similar exposure to these issues as boys. In any case, this is a possible line of future research.

Notably, levels of IGD and online gambling disorder were significantly higher at T2 for those who had bought LBs in the previous six months regardless of whether they had purchased LBs at T1. Although the differences were significant in this regard, it is important to note that the scores in the IGDS9-SF and OGD-Q do not necessarily indicate clinical diagnosis as this would require a formal clinical evaluation. The results may suggest that not purchasing LBs in the past six months is a sufficient time window to protect minors or indicate that not purchasing LBs in the past six months is already associated with lower scores on the IGD and OGD-Q scales. This may also be examined in future studies.

However, there are no current longitudinal studies with which to compare these data in minors. Almost all studies to date have established a relationship between buying LBs and IGD (Montiel et al., 2022), especially using the IGDS9-SF (Evren et al., 2021; González-Cabrera et al., 2022). Another aspect that may help understanding these results is the way LBs are evaluated. This study defined exposure as having purchased LBs in the past 12 months, not just opening them, which is an important aspect in the context of gaming (Garea et al., 2021; Gibson et al., 2022; Montiel et al., 2022). This distinction has been addressed by authors who differentiated between buying and opening LBs, with the latter being almost twice as prevalent as the former (Brooks & Clark, 2019; Kristiansen & Severin, 2020).

It is possible that the opening of LBs is more strongly related to online gaming behaviors; many video games reward players with these items when they complete quests, obtain achievements, and generally perform in-game actions involving substantial investment of time (especially in online and multiplayer games). Thus, it is necessary that future research investigating the associations between LBs with IGD and online gambling disorder differentiate between opening free LBs, LBs obtained through time invested in the video game, and LBs acquired with real money to separately (Montiel et al., 2022).

#### 4.1. Limitations and directions for future research

Despite its novel findings and important contributions, this study has some potential limitations. First, the results were based on a self-report methodology with the limitations this entails (e.g., minors endorsing the criteria for IGD or OGD did not have a formal diagnosis validated by a health practitioner). Second, due to the longitudinal design adopted in this study, a retrospective bias may also have been introduced when the participants were asked about their actions over the past six months. It should also be noted that a design with only two time points has its own limitations and studies with at least three waves will be needed in the future. Third, despite the effort made to obtain a large sample of adolescents at both time points, there was a high rate of attrition due to variables outside the researchers' control. In addition, there are only small numbers of minors with OGD and IGD, which is in line with the literature. Fourth, it is possible that there were bidirectional relationships that were not analyzed between gambling at T1 and buying LBs at T2. These aspects may be examined in future studies. Fifth, this study

was conducted among a young population that may not have had access to the financial requirements of online gambling; this age range excluded the crucial time period in which children gain legal and financial access to gambling. Future studies should include a large sample of minors and adults across a wider age range to analyze possible differences. Nevertheless, this study has particular strengths in that it focused on a representative sample of adolescents from a large Spanish region and attempted to relate LB purchases to clinical problems.

At this point in the evolution of video gaming, the prevention of OGD behaviors is crucial. Moreover, in the present study, special emphasis was placed on the clinical perspective of gaming and gambling (with assessment tools that followed the DSM-5 diagnostic criteria), which is infrequent in existing literature (Garea et al., 2021; Gibson et al., 2022; Montiel et al., 2022; Poon et al., 2021). We also believe that this is the first study to link LB purchasing to clinical problems with video games and gambling. In the current state of research on LBs, the association between their purchase and possible gambling problems over time is particularly relevant. This research could be considered as the pioneer in this line and therefore further efforts should be made in the future.

The implications of this study may be relevant to the strategic decision making of governments in several ways. First, considering the data presented and the evidence accumulated, it should be mandatory for video games containing LBs to have an 18-year-old label and an explicit notice of “gambling” so that consumers are aware of the potential risks included in such video games. This must be duly reflected in self-regulatory systems designed by the industry to provide its consumers with indicative information on the appropriate age for consumption (such systems include the Pan European Game Information—PEGI—or the Entertainment Software Rating Board—ESRB—for the United States, Canada, or Mexico and in other systems according to countries and geographical areas).

This is particularly important following the study by Garrett et al. (2023), which suggested that consumers do not seem to understand the PEGI/ESRB LB warnings. Therefore, current warnings may not adequately inform consumers’ spending decisions, and changes such as those suggested should be incorporated. Second, it is crucial for public administrations to carry out information and awareness campaigns on this issue (for families and minors) in non-university school contexts, because the purchase of LBs is pervasive within the population and is often not perceived as a bet.

The present study concludes that purchasing LBs is a prevalent and stable phenomenon among a sample of Spanish adolescents (under 18 years old) and that there is a positive relationship between the purchase of LBs and gambling online six months later. In contrast, the relationship between purchasing LBs and presenting a diagnosis of online gambling disorder or IGD requires further study.

#### Credit author statement

Joaquín González-Cabrera: Conceptualization, Methodology, Data curation, Formal analysis Writing – original draft, Writing – review & editing, Supervision, Funding acquisition. Aranzazu Basterra-González: Investigation, Data curation, Writing – review & editing. Jessica Ortega-Barón: Writing – original draft, Writing- Reviewing and Editing. Vanessa Caba-Machado: Writing – original draft, Writing- Reviewing and Editing. Adoración Díaz-López: Writing – original draft, Writing- Reviewing and Editing. Halley Pontes: Writing – review & editing. Juan M. Machimbarrena: Conceptualization, Methodology, Data curation, Formal analysis, Writing – original draft, Writing- Reviewing and Editing.

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#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Data availability

Data will be made available on request.

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