

Blind box over-engagement and suicide risk among adolescents and young adults: Results of a large-scale survey

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Summary

Background Gambling appears to be an independent risk factor for suicide among the young population worldwide. Blind boxes are collectable toys packed randomly in the box, which share certain similarities with gambling and are popular among the young population. This is the first study that examined the association between blind box engagement and suicide risk in the young population, the leading consumption group of blind boxes.

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Methods This study is part of a large-scale, cross-sectional study using convenience sampling conducted Oct 26 to Nov 18, 2021, which covered all the university and college students in the Jilin province, China. A total of 73,206 participants completed the survey with valid data for the current study (male: $N = 28,762$; female: $N = 44,444$; Mean age = 19.59). Participants' blind box engagement, suicide risk, depression, anxiety, alcohol use, smoking habit, and sociodemographic characteristics were assessed. First, we used univariate and multivariable binary logistic regression models to examine the relationship between blind box engagement and suicide risk in all participants. Second, we tested whether depression and anxiety would mediate the association between blind box engagement and suicide risk. Third, we analysed the association between "Frequency (i.e., frequency of blind box engagement)," "Bet (i.e., expenditure on the blind box that exceeds affordability)," "Tolerance (i.e., level of addiction)," "Borrowed (i.e., the amount of money borrowed for blind box engagement)," and suicide risk in the group with blind box engagement history.

Findings 4,195 participants (5.73%) have engaged in blind boxes, with 3,255 females (77.59%) and 940 males (22.41%). In the univariate models, binary logistic regression showed that blind box engagement was associated with suicide risk in both male and female participants (male: OR = 2.21, 95% CI = 1.86–2.63; female: OR = 1.64, 95% CI = 1.50–1.78). In the multivariable models, after controlling age, subjective socioeconomic status, per capita disposable income, alcohol use, and smoking habit, blind box engagement still was associated with suicide risk across genders (male: OR = 2.25, 95% CI = 1.89–2.68; female: OR = 1.58, 95% CI = 1.45–1.73). Depression (male: indirect effect = 0.31, SE = 0.04, $p < 0.001$; female: indirect effect = 0.20, SE = 0.02, $p < 0.001$) and anxiety (male: indirect effect = 0.26, SE = 0.03, $p < 0.001$; female: indirect effect = 0.13, SE = 0.02, $p < 0.001$) mediate the association between blind box engagement and suicide risk. Within the blind box engagement group, forward binary logistic regression revealed that "Tolerance" was associated with participants' suicide risk in both males ($p = 0.001$) and females ($p < 0.001$); "Borrowed" ($p = 0.019$) alone was associated with the male participants' suicide risk.

Interpretation Our findings showed that blind box over-engagement is positively associated with suicide risk in both young males and females, and this association persisted after adjusting for influencing factors. In spite of the

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limitations in this study (e.g., cross-sectional, convenience sampling), current findings can assist policymakers in developing regulations for such a prosperous youth-dominant consumption industry while protecting youth's mental health worldwide.

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Keywords: Suicide; Adolescents; Young population; Blind box; Gambling

Research in context

Evidence before this study

We searched PubMed, Web of Science, and PsycInfo from database inception until April 24, 2022, with the language restriction in English, using the following search terms: "blind box," "mystery box," "gift box," "gashapon," "lucky bag," "suicide," "suicidality," "suicide risk," "mental health," "gambling," "gamble," "problem gambling," "gambling disorder," "loot box," and "gender difference." No studies were identified that investigated the relationship between the 'real or entity version' of the virtual video game loot box (i.e., blind box) engagement and suicide risk. Given that increasing numbers of studies have steadily found virtual video game loot boxes are associated with gambling, we speculate such a relationship may extend to blind boxes, suggesting blind box engagement may be associated with gambling while predicting suicide risk.

Added value of this study

This study provides initial evidence regarding the association between blind box engagement and suicide risk in a large sample of adolescents and young adults. Our findings indicated that blind box engagement was associated with suicide risk, and depression and anxiety were possible mediators. In addition, our results indicated gender differences in the association between blind box engagement behaviours (i.e., "Frequency," "Bet," "Tolerance," and "Borrowed") and suicide risk.

Implications of all the available evidence

Our findings support government agencies to take relevant measures to regulate the blind box industry (e.g., setting age and price limits, publishing probability disclosures, avoiding overmarketing), which could reduce potential harm to the young population. In the future, in-depth investigations are needed to assist policymakers in determining the appropriate degree of supervision, designing relevant regulations, and eventually protecting adolescent and young adults' mental health.

Introduction

Suicide is an increasingly prevalent public health problem and one of the leading causes of death among young adults worldwide.^{1,2} The association between gambling and suicide has been underlined by previous studies from Sweden, Spain, Canada, China, and South Korea,^{3–5} with approximately 20% of suicide victims engaging in gambling behaviours.⁶ More than 80% of university counselling centres reported that college students had increasing mental health risks, among which gambling and attempted suicide were common ones.⁷ One previous British study showed that after controlling influencing factors (e.g., sociodemographic factors, alcohol use, video gaming, impulsivity, and life satisfaction), there was still a significant association between problem gambling and attempted suicide in young people aged 16–24 years.² Furthermore, suicidal ideation and behaviours were more likely to be associated with gambling problems in women as compared to men.⁸

In recent years, one research area in gambling attracting increasing attention is virtual video game loot box (also called loot crate, loot case, or loot chest), which aims to induce players' purchase behaviours by offering enhanced experiences during online gaming. Players can open virtual video game loot boxes containing random content using purchased keys or obtained in-game items.⁹ Some studies found that loot box engagement was correlated with problem gambling, and there were significant gender differences.^{10,11} Findings from several meta-analyses revealed that there was a small-to-moderate positive correlation between virtual video game loot box purchases and psychological distress manifested in mood shifts.^{12–14} Virtual video game loot box consumption was significantly associated with mood shifts.¹⁵ The postulation behind such an association could be spending on items that fit people's personalities might be a symbolic way to express oneself, leading to positive emotions,¹⁶ while overbudget spending might subsequently transform those positive emotions into negative ones, causing mood shifts.

It is worth noting that regular gamers who indulged in virtual video game loot boxes could suffer from financial harm (i.e., reduced savings and bankruptcy) and psychological harm (i.e., regret, anger, worthless,

escape, vulnerability, distress, failure, hopelessness, and shame),¹⁷ which may lead to elevated suicide risk in the future.¹⁸ Based on these findings, regulators in many countries, such as Belgium, Denmark, the Netherlands, and the United States, are paying extra attention to regulating virtual video game loot box engagement.^{9,19–21} For example, Drummond and Sauer recommended that rating agencies and gambling regulators should review video games with virtual video game loot boxes. To help juvenile players and parents make informed decisions, the employment of additional parental advisory information about virtual video game loot boxes in games should be required.²²

Previous research has claimed that physical toys are sold in real-life loot boxes in systems such as the Japanese ‘Gacha.’ Players only know that their blindly purchased toy will come from a pre-determined set of toys, the same form as blind boxes. Therefore, blind boxes could be deemed as the ‘real or entity version’ of the virtual video game loot boxes.²³ Similar to the randomised nature of virtual video game loot boxes, blind boxes (also called Fukubukuro, meaning a mystery or gift box in Japanese) contain collectable toys packed randomly in capsules or boxes, and consumers can only know the contents by opening the box after purchase.²⁴ In China, blind boxes are frequently sold in offline vending machines, offline brick-and-mortar stores in large shopping malls, official websites of blind box manufacturers, and e-commerce flagship stores on influential and commonly used online retail platforms.²⁵ The impact of blind boxes on Chinese netizens has been continually growing, with over 270 million reads and 290,000 discussions on blind boxes on Weibo, one of the most commonly used social media platforms in China, indicating its dominance in pop culture.²⁶ Findings from previous research revealed that the major consumer crowd of blind boxes is youth aged between 18 to 24 years,²⁵ accounting for 37.6%, and within which the majority were female, accounting for 62.6%. However, despite its prosperity, there is little sound research on blind boxes, the physical, real-world equivalent to virtual video game loot boxes.

The major difference between blind boxes and virtual video game loot boxes is that virtual loot boxes’ in-game value cannot be directly transferred outside the virtual game for real-world currency, whereas blind boxes contain physical collectables that can be directly sold in exchange for real-world currency, underscoring its potential correlation with gambling. Blind box engagement resembles gambling when referring to Griffith’s criteria of gambling,²⁷ including 1) involves money exchange; 2) the final product of such exchange is unknown and unpredictable; 3) the final product during engagement is determined purely, or at least partially, by chance. Regulators in Shanghai, China, have introduced relevant policies (e.g., setting content, age, and price limits, publishing probability disclosures,

avoiding overmarketing, and implementing “pity mechanics”) that indicate blind box engagement may relate to gambling since blind box engagement could incur increased economic pressure and even debt on some occasions, suggesting the current situation warrants further guidance and regulations.²⁸

The association between gambling and suicide has been well underscored by previous research,^{2,7,29} we hypothesised that blind box engagement shares a similar psychological mechanism as gambling. Therefore, this study aims to explore: 1) whether blind box over-engagement is associated with suicide risk; 2) whether there are gender differences within the relationship between blind box engagement and suicide risk.

Methods

Data source and participants

This study is part of a large-scale, cross-sectional study conducted in 2021 (October 26th to November 18th) that covered all the university and college students in the Jilin province, China. The purpose of the survey is to understand the behaviour and mental health status of college students in Jilin Province. Jilin University granted ethical approval for this study. The researchers created a Quick Response code (i.e., QR code) and distributed it to all universities and colleges in Jilin Province. Participants from 63 universities and colleges have completed informed consent and participated in this study. Online informed consent was obtained from all participants on the information page before filling out the questionnaire. Participants were also informed of their right to withdraw from the survey at any time. All participants were further provided with information on accessing mental health support should they become upset at any point during or after the study. The collected data was safely stored in the specific computer server with password protection in the Vanke School of public health of Tsinghua University, Beijing, China. Only specific personnel, including research assistants who have been informed and trained with data confidentiality, research fellows who have been acquainted with the confidentiality agreement and procedures, and the principal investigator, can view and analyse the data. Please refer to the appendix for checklist for reporting results of internet e-surveys (CHERRIES).

The inclusion criteria include: 1) aged above 15 years old; 2) studying in universities or colleges in Jilin Province, China; 3) able to understand the content of the questionnaire; 4) three out of the four attention check questions were corrected (e.g., “In any case, please choose ‘green’ for this question”); 5) the value of height or weight was not abnormal; 6) Not having logical contradiction, omission of the answer, or selection of options not concerned the current study’s objectives (e.g., addictive behaviours); 7) without apparent regularity in options (e.g., almost all choose the first option). After

screening, 73,206 participants were qualified for this current study, among which 28,762 were males (39.29%) and 44,444 were females (60.71%). The mean age of the sample is 19.59 (SD = 1.75).

Measures

Five items were used to measure blind box engagement. First, participants were asked to indicate whether they engaged in the blind box (i.e., participants have purchased a blind box at least once in the past year) and report the frequency of engagement in the past 12 months. Second, due to the lack of an existing measurement scale specifically targeting measuring blind box engagement, we referred to the items for measuring gambling behaviours in the Problem Gambling Severity Index (PGSI) (with good reliability, Cronbach's alpha = 0.77)³⁰ to develop the following items, including "Bet" (i.e., "Have you spent on blind boxes more than you could really afford to lose in the past 12 months?"), "Tolerance" (i.e., "Have you needed to buy blind boxes with larger amounts of money to get the same feeling of excitement in the past 12 months?"), and "Borrowed" (i.e., "Have you borrowed money or sold anything to buy blind boxes in the past 12 months?"). As we focus on the behaviour of blind box engagement, we only adapted the first four questions of the PGSI into the questions of measuring the blind box engagement. Item 3 (i.e., Chase) is not suitable for asking about the blind box engagement because buying blind boxes is not a zero-sum game, and there is no winner or loser. So we did not include "Chase" in the final analysis. According to blind box engagement's resemblance to gambling according to Griffith's criteria of gambling, among the three items, "Bet" and "Borrowed" were developed to measure the first shared similarity (i.e., the amount of money exchanged), while "Tolerance" was developed to measure the second and third shared similarity (i.e., participants mental shifts towards addiction when facing excitements from unpredictability and chance events).

The Chinese version of the Suicidal Behaviours Questionnaire-Revised (SBQ-R) has four items,^{31,32} each investigating a different dimension of suicide risk: suicidal ideation and attempts in a lifetime (Item 1), the frequency of suicidal ideation over the past 12 months (Item 2), the threat of suicide attempt (Item 3), and future likelihood of suicidal behaviour (Item 4). A total score of this measure, ranging from 3 to 18, was obtained by summing the scores of all the items, with higher scores indicating higher levels of suicide risk. The cut-off score for determining levels of suicide risk was 7. In this study, Cronbach's alpha value was 0.78.

The Chinese version of the Patient Health Questionnaire-9 (PHQ-9)³³ is a self-report nine-item scale used to assess and monitor depression severity. Each item of the PHQ-9 ranges from 0 to 3, with a summed score ranging from 0 to 27. In this study, Cronbach's alpha of

the Chinese version of the PHQ-9 was 0.89. The Chinese version of the Generalised Anxiety Disorder Questionnaire (GAD-7)³⁴ is a self-report seven-item scale used to assess and screen anxiety severity. Each item of the GAD-7 ranges from 0 to 3, with a summed score ranging from 0 to 21. In this study, Cronbach's alpha of the Chinese version of the GAD-7 was 0.92.

Participants' substance use, including drinking frequency and smoking habit, was measured by two questions. Participants were asked to answer the questions (i.e., "How often do you drink alcohol in past year?"; "Do you have the habit of smoking at present?") and choose the option that fitted the best (i.e., "Never," "Once a month or less," "2-4 times a month," "2-3 times a week," or "4 times a week or more."; "Yes" or "No").

The participants' age, gender, subjective socioeconomic status, and per capita disposable income were also collected. The Macarthur scale of subjective socioeconomic status was presented to participants in a ladder format, with each of the ten steps corresponding to a specific socioeconomic level.³⁵ Based on the picture, participants rated their family class on a scale from 1 to 10 points, indicating their places in the social hierarchy. With higher number indicate the subjective socioeconomic status was higher. Per capita disposable income refers to each individual's average purchase power. According to the China Statistical Yearbook,³⁶ six options were set for participants to choose from, including "less than 6,000 yuan per year", "6,000-14,000 yuan per year", "14,000-23,000 yuan per year", "23,000-36,000 yuan per year", "36,000-70,000 yuan per year" and "more than 70,000 yuan per year".

Statistical analysis

All analyses were performed separately for male and female participants. First, the Chi-square test was used to examine the differences in suicide risks across genders and blind box engagement. Second, univariate binary logistic regression models were used in all participants to test the association between blind box engagement and suicide risk. Third, we tested whether depression and anxiety would mediate the association between blind box engagement and suicide risk. Fourth, we analysed the adjusted association between blind box engagement and suicide risk in a multivariable model. Fifth, for the group who had blind box engagement history, binary logistic regression was conducted for all univariates to explore the unadjusted association between these variables and suicide risks. Finally, variables shown to be statistically significant in the previous step were incorporated into the forward binary logistic regression models (i.e., a selection method using likelihood ratio) to further explore the adjusted association.

We performed multicollinearity diagnoses for independent variables, including age, subjective socioeconomic status, per capita disposable income, alcohol use, smoking habit, and four kinds of blind box engagement

behaviours. All variables' variance inflation factor values were less than 2, suggesting the correlation between independent variables was not close.³⁷ Researchers also examined the unadjusted and adjusted association between the independent variables and suicide risks while reporting the odds ratio (OR) and confidence interval (CI).

Role of the funding source

The funding source had no involvement in the study design, in the collection, analysis, and interpretation of data, in the writing of the report, and in the decision to submit the paper for publication. All authors had full access to all the data in the study and confirmed their responsibility for the decision to submit it for publication.

Results

4195 (5.73%) participated in blind box engagement, and 69,011 (94.27%) have not. Among the 4195 blind box engaged participants, there were 940 (22.41%) males and 3255 (77.59%) females. Compared with the proportion of female participants in the total population (60.71%), the proportion of female participants in the blind box engagement group is higher.

Overall, 9891 (13.51%) participants were at suicide risk. As in [Figure 1](#), comparing with group without blind box engagement, blind box engagement group

had significant higher suicide risk [χ^2 (1, $N = 73,206$) = 287.04; $p < 0.001$], which existed in both male participants [χ^2 (1, $N = 28,762$) = 84.62; $p < 0.001$] and females [χ^2 (1, $N = 44,444$) = 130.19; $p < 0.001$].

The binary logistic regression showed that blind box engagement was associated with suicide risk in both male and female participants (male: OR = 2.21, 95% CI = 1.86-2.63; female: OR = 1.64, 95% CI = 1.50-1.78) in the univariate models. [Figure 2](#) presented that depression mediated the association between blind box engagement and suicide risk in both male and female participants (male: indirect effect = 0.31, $SE = 0.04$, $p < 0.001$; female: indirect effect = 0.20, $SE = 0.02$, $p < 0.001$). Anxiety mediated the association between blind box engagement and suicide risk in both male and female participants (male: indirect effect = 0.26, $SE = 0.03$, $p < 0.001$; female: indirect effect = 0.13, $SE = 0.02$, $p < 0.001$). After controlling age, subjective socioeconomic status, per capita disposable income, alcohol use, and smoking habit, blind box engagement could still be associated with suicide risk (male: OR = 2.25, 95% CI = 1.89-2.68; female: OR = 1.58, 95% CI = 1.45-1.73) in the multivariable model ([Table 1](#)).

In the blind box engagement group ([Table 2](#)), subjective socioeconomic status and four kinds of blind box engagement behaviours were associated with the risk of suicide in both genders ($p < 0.001$). Alcohol use and smoking habit were associated with suicide risk only in

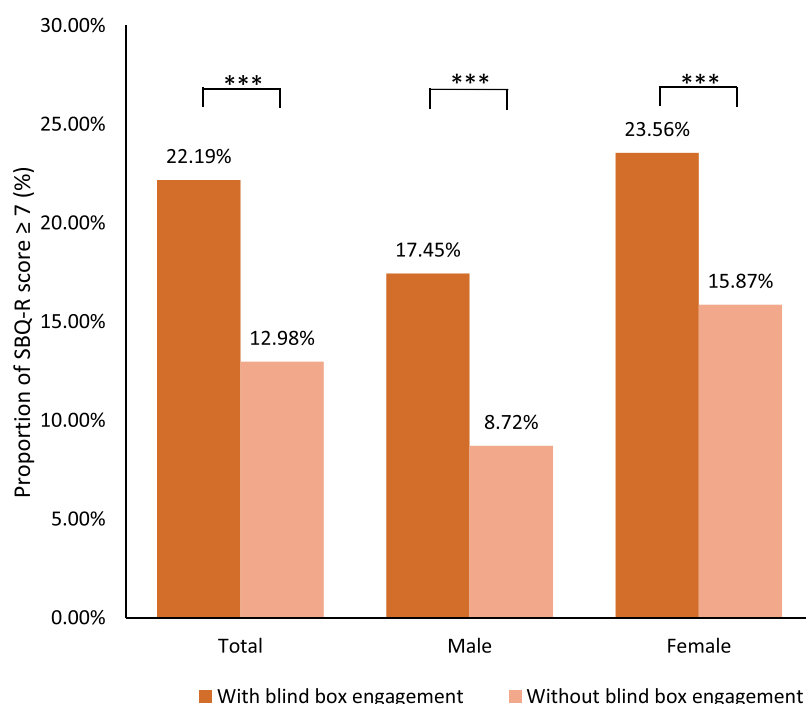


Figure 1. Suicide risk and blind box engagement by gender.

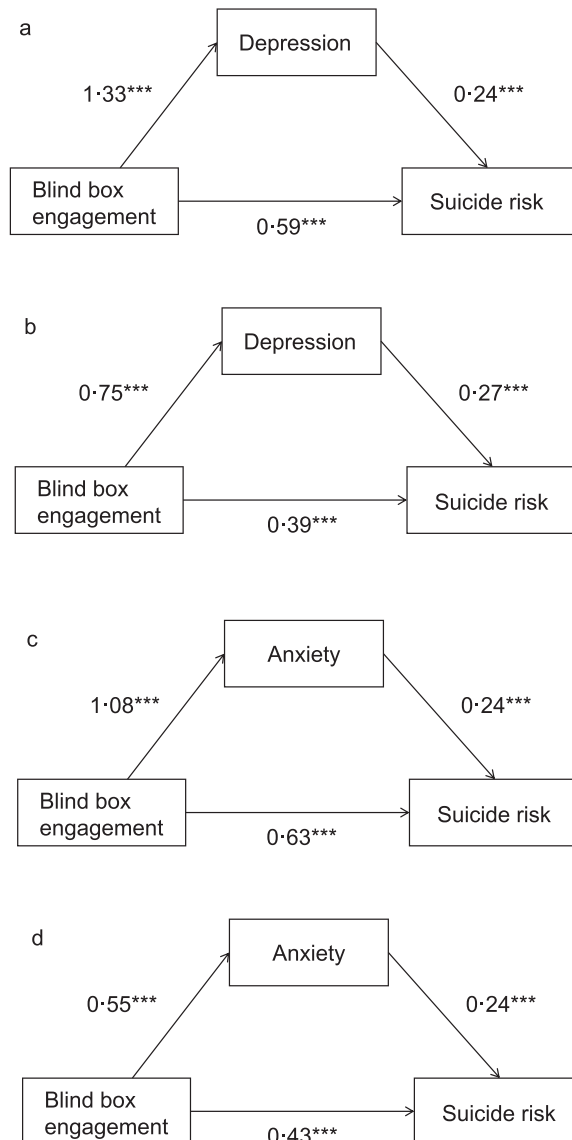


Figure 2. Mediation models of depression and anxiety by gender.

Note. a: mediation model of depression in male participants ($N = 28,762$); b: mediation model of depression in female participants ($N = 44,444$); c: mediation model of anxiety in male participants ($N = 28,762$); d: mediation model of anxiety in female participants ($N = 44,444$). *** indicates $p < 0.001$.

female participants ($p < 0.001$). Age and per capita disposable income were not associated with suicide risk in different genders ($p > 0.05$). For further details, please refer to [Table 2](#).

Based on the results of univariate analysis, only significant variables were included in the multivariable models, and forward binary logistic regression was performed based on genders. The degree of conformity of the models were tested by the Hosmer-Lemeshow test [male: $\chi^2 (7, N = 3,255) = 5.69, p = 0.576$; female: $\chi^2 (7, N = 940) = 2.59, p = 0.920$], indicating that the fitting degree of the models were good. In the model for male

participants ([Table 3](#)), three variables that were significantly associated with the risk of suicide were retained: 1) "Borrowed," 2) "Tolerance," and 3) subjective socioeconomic status. In the model for female participants ([Table 4](#)), four variables associated with the risk of suicide were retained: 1) alcohol use, 2) "Tolerance," 3) subjective socioeconomic status, and 4) smoking habit.

Discussion

This is the first study investigating the association between blind box engagement and suicide risk among

	Male participants					Female participants				
	N (%)	Unadjusted OR (95% CI)	p value	Adjusted OR (95% CI)	p value	N (%)	Unadjusted OR (95% CI)	p value	Adjusted OR (95% CI)	p value
Age										
Mean, years (SD)	19.64 (1.82)	0.99 (0.97-1.02)	0.558	0.99 (0.97-1.02)	0.498	19.56 (1.70)	1.01 (0.99-1.02)	0.426	1.00 (0.99-1.02)	0.945
Subjective Socioeconomic Status										
Mean (SD)	4.33 (1.76)	0.87 (0.85-0.89)	<0.001	0.85 (0.82-0.87)	<0.001	4.56 (1.56)	0.87 (0.85-0.88)	<0.001	0.84 (0.82-0.86)	<0.001
Per capita disposable income										
<6,000 yuan/year	8542 (29.70%)	1 (ref)		1 (ref)		14083 (31.69%)	1 (ref)		1 (ref)	
6,000-14,000 yuan/year	9111 (31.68%)	1.03 (0.93-1.14)	0.609	1.17 (1.05-1.30)	0.004	14742 (33.17%)	0.94 (0.88-1.00)	0.041	1.03 (0.96-1.10)	0.390
14,000-23,000 yuan/year	4754 (16.53%)	1.02 (0.90-1.15)	0.743	1.26 (1.10-1.43)	0.001	7198 (16.20%)	0.92 (0.85-1.00)	0.039	1.05 (0.97-1.14)	0.212
23,000-36,000 yuan/year	2767 (9.62%)	0.86 (0.74-1.01)	0.059	1.12 (0.95-1.32)	0.190	4219 (9.49%)	0.87 (0.80-0.96)	0.006	1.05 (0.95-1.16)	0.356
36,000-70,000 yuan/year	2031 (7.06%)	0.99 (0.84-1.17)	0.917	1.34 (1.12-1.60)	0.001	2646 (5.95%)	1.06 (0.95-1.18)	0.297	1.30 (1.15-1.46)	<0.001
>70,000 yuan/year	1557 (5.41%)	0.86 (0.70-1.05)	0.131	1.26 (1.02-1.56)	0.036	1556 (3.50%)	1.05 (0.91-1.20)	0.507	1.27 (1.09-1.47)	0.002
Alcohol use										
Non-drinker	7876 (27.38%)	1 (ref)		1 (ref)		24400 (54.90%)	1 (ref)		1 (ref)	
≤1 time a month	14787 (51.41%)	0.98 (0.89-1.08)	0.645	0.95 (0.86-1.05)	0.324	16975 (38.19%)	1.52 (1.44-1.60)	<0.001	1.45 (1.37-1.53)	<0.001
2-4 times a month	4875 (16.95%)	1.21 (1.07-1.37)	0.002	1.18 (1.04-1.34)	0.013	2493 (5.61%)	2.84 (2.59-3.12)	<0.001	2.44 (2.21-2.69)	<0.001
2-3 times a week	774 (2.69%)	1.55 (1.24-1.94)	<0.001	1.52 (1.20-1.91)	<0.001	386 (0.87%)	4.04 (3.28-4.98)	<0.001	3.18 (2.56-3.95)	<0.001
≥4 times a week	450 (1.56%)	2.38 (1.85-3.06)	<0.001	2.33 (1.80-3.02)	<0.001	190 (0.43%)	3.62 (2.68-4.89)	<0.001	2.83 (2.07-3.86)	<0.001
Smoking habit										
No	21362 (74.27%)	1 (ref)		1 (ref)		43161 (97.11%)	1 (ref)		1 (ref)	
Yes	7400 (25.73%)	1.11 (1.01-1.22)	0.024	1.03 (0.93-1.13)	0.589	1283 (2.89%)	3.41 (3.04-3.83)	<0.001	2.35 (2.08-2.65)	<0.001
Depression										
Mean (SD)	4.48 (4.46)	1.27 (1.26-1.28)	<0.001	—	—	4.97 (4.21)	1.31 (1.30-1.32)	<0.001	—	—
Anxiety										
Mean (SD)	3.11 (3.81)	1.28 (1.27-1.29)	<0.001	—	—	3.68 (3.74)	1.28 (1.27-1.29)	<0.001	—	—
Blind box engagement										
No	27822 (96.73%)	1 (ref)		1 (ref)		41189 (92.68%)	1 (ref)		1 (ref)	
Yes	940 (3.27%)	2.21 (1.86-2.63)	<0.001	2.25 (1.89-2.68)	<0.001	3255 (7.32%)	1.64 (1.50-1.78)	<0.001	1.58 (1.45-1.73)	<0.001

Table 1: Unadjusted and adjusted odds ratios (ORs) for suicide risk in all participants.

	Male participants			Female participants		
	N (%)	OR (95% CI)	p value	N (%)	OR (95% CI)	p value
Age						
Mean, years (SD)	19.65 (1.77)	1.04 (0.95-1.14)	0.394	19.57 (1.77)	1.02 (0.97-1.07)	0.416
Subjective Socioeconomic Status						
Mean (SD)	4.61 (1.80)	0.83 (0.76-0.92)	<0.001	5.03 (1.53)	0.84 (0.80-0.89)	<0.001
Per capita disposable income						
<6,000 yuan/year	203 (21.60%)	1 (ref)		633 (19.45%)	1 (ref)	
6,000-14,000 yuan/year	271 (28.83%)	0.86 (0.54-1.37)	0.511	923 (28.36%)	1.05 (0.83-1.33)	0.682
14,000-23,000 yuan/year	188 (20.00%)	0.93 (0.56-1.54)	0.785	689 (21.17%)	0.96 (0.75-1.24)	0.775
23,000-36,000 yuan/year	105 (11.17%)	0.90 (0.49-1.65)	0.734	438 (13.45%)	0.86 (0.64-1.15)	0.315
36,000-70,000 yuan/year	89 (9.47%)	0.58 (0.28-1.18)	0.131	359 (11.03%)	0.75 (0.55-1.04)	0.081
>70,000 yuan/year	84 (8.93%)	0.68 (0.34-1.37)	0.280	213 (6.54%)	1.01 (0.70-1.44)	0.980
Alcohol use						
Non-drinker	179 (19.04%)	1 (ref)		1287 (39.54%)	1 (ref)	
≤1 time a month	494 (52.56%)	1.21 (0.75-1.94)	0.443	1553 (47.71%)	1.50 (1.25-1.81)	<0.001
2-4 times a month	210 (22.34%)	1.43 (0.83-2.45)	0.195	338 (10.39%)	3.22 (2.48-4.17)	<0.001
2-3 times a week	41 (4.36%)	1.90 (0.83-4.33)	0.128	59 (1.81%)	2.81 (1.62-4.85)	<0.001
≥4 times a week	16 (1.70%)	1.36 (0.36-5.10)	0.650	18 (0.55%)	3.78 (1.47-9.67)	<0.001
Smoking habit						
No	748 (79.57%)	1 (ref)		3131 (96.19%)	1 (ref)	
Yes	192 (20.43%)	1.27 (0.85-1.90)	0.242	124 (3.81%)	3.00 (2.09-4.31)	<0.001
Frequency						
≥1 times/year	487 (51.81%)	1 (ref)		1614 (49.59%)	1 (ref)	
≥1 times/six months	166 (17.66%)	1.49 (0.93-2.38)	0.096	585 (17.97%)	1.16 (0.92-1.45)	0.209
≥1 times/three months	117 (12.45%)	1.10 (0.62-1.97)	0.737	519 (15.94%)	1.03 (0.81-1.31)	0.801
≥1 times/month	122 (12.98%)	2.41 (1.49-3.88)	<0.001	430 (13.21%)	1.55 (1.22-1.97)	<0.001
≥1 times/week	35 (3.72%)	4.33 (2.10-8.94)	<0.001	83 (2.55%)	2.98 (1.90-4.67)	<0.001
≥1 times/day	13 (1.38%)	2.89 (0.86-9.64)	0.085	24 (0.74%)	1.85 (0.79-4.37)	0.158
Bet^a						
Never	627 (66.70%)	1 (ref)		2404 (73.86%)	1 (ref)	
Rarely	203 (21.60%)	2.12 (1.42-3.16)	<0.001	613 (18.83%)	1.36 (1.11-1.67)	0.003
Sometimes	67 (7.13%)	2.15 (1.17-3.94)	0.014	180 (5.53%)	2.05 (1.49-2.83)	<0.001
Often	28 (2.98%)	5.13 (2.34-11.24)	<0.001	43 (1.32%)	4.28 (2.33-7.86)	<0.001
Almost always	15 (1.59%)	7.81 (2.76-22.13)	<0.001	15 (0.46%)	3.26 (1.18-9.03)	0.023
Tolerance^b						
Never	591 (62.87%)	1 (ref)		2266 (69.62%)	1 (ref)	
Rarely	212 (22.55%)	2.27 (1.52-3.41)	<0.001	646 (19.84%)	1.34 (1.10-1.65)	<0.001
Sometimes	97 (10.32%)	3.23 (1.95-5.33)	<0.001	239 (7.34%)	2.37 (1.79-3.13)	<0.001
Often	26 (2.77%)	3.36 (1.41-8.02)	<0.001	77 (2.37%)	3.44 (2.17-5.44)	<0.001
Almost always	14 (1.49%)	13.62 (4.44-41.81)	<0.001	27 (0.83%)	4.89 (2.28-10.53)	<0.001
Borrowed^c						
Never	777 (82.66%)	1 (ref)		2965 (91.09%)	1 (ref)	
Rarely	91 (9.68%)	1.95 (1.16-3.29)	0.012	171 (5.25%)	1.69 (1.22-2.36)	0.002
Sometimes	47 (5.00%)	3.80 (2.04-7.09)	<0.001	100 (3.07%)	2.22 (1.48-3.36)	<0.001
Often	18 (1.91%)	9.63 (3.65-25.38)	<0.001	17 (0.52%)	3.91 (1.50-10.18)	0.005
Almost always	7 (0.75%)	8.17 (1.80-37.01)	0.006	2 (0.06%)	3.48 (0.22-55.69)	0.378

Table 2: Unadjusted odds ratios (ORs) for suicide risk in the blind box engagement group.

^a Bet (i.e., "Have you spent on blind boxes more than you could really afford to lose in the past 12 months?").

^b Tolerance (i.e., "Have you needed to buy blind boxes with larger amounts of money to get the same feeling of excitement in the past 12 months?").

^c Borrowed (i.e., "Have you borrowed money or sold anything to buy blind boxes in the past 12 months?").

Male participants	Model one		Model two		Model three	
	OR (95% CI)	<i>p</i> value	OR (95% CI)	<i>p</i> value	OR (95% CI)	<i>p</i> value
Borrowed^a						
Never	1 (ref)		1 (ref)		1 (ref)	
Rarely	1.95 (1.16-3.29)	0.012	1.31 (0.75-2.30)	0.347	1.19 (0.67-2.11)	0.561
Sometimes	3.80 (2.04-7.09)	<0.001	2.50 (1.24-5.04)	0.011	2.27 (1.12-4.60)	0.023
Often	9.63 (3.65-25.38)	<0.001	6.12 (2.10-17.86)	0.001	5.09 (1.70-15.20)	0.004
Almost always	8.17 (1.80-37.01)	0.006	2.90 (0.47-17.84)	0.251	3.00 (0.48-18.74)	0.240
Tolerance^b						
Never	---		1 (ref)		1 (ref)	
Rarely	---		2.01 (1.30-3.10)	0.002	2.04 (1.32-3.15)	0.001
Sometimes	---		2.01 (1.11-3.62)	0.020	2.17 (1.19-3.96)	0.011
Often	---		1.58 (0.58-4.32)	0.374	1.47 (0.54-4.01)	0.457
Almost always	---		7.83 (2.22-27.61)	0.001	7.97 (2.22-28.67)	0.001
Subjective socioeconomic status						
score	---		---		0.86 (0.77-0.95)	0.003

Table 3: Adjusted odds ratios (ORs) for suicide risk in male participants with blind box engagement.

^a Tolerance (i.e., "Have you needed to buy blind boxes with larger amounts of money to get the same feeling of excitement in the past 12 months?").

^b Borrowed (i.e., "Have you borrowed money or sold anything to buy blind boxes in the past 12 months?").

Female participants	Model one		Model two		Model three		Model four	
	OR (95% CI)	<i>p</i> value	OR (95% CI)	<i>p</i> value	OR (95% CI)	<i>p</i> value	OR (95% CI)	<i>p</i> value
Alcohol use								
Non-drinker	1 (ref)		1 (ref)		1 (ref)		1 (ref)	
≤1 time a month	1.50 (1.25-1.81)	<0.001	1.48 (1.23-1.78)	<0.001	1.48 (1.23-1.78)	<0.001	1.46 (1.21-1.76)	<0.001
2-4 times a month	3.22 (2.48-4.17)	<0.001	2.97 (2.28-3.87)	<0.001	3.08 (2.36-4.02)	<0.001	2.87 (2.19-3.77)	<0.001
2-3 times a week	2.81 (1.62-4.85)	<0.001	2.40 (1.37-4.20)	0.002	2.36 (1.34-4.15)	0.003	2.07 (1.17-3.67)	0.012
≥4 times a week	3.78 (1.47-9.67)	0.006	3.39 (1.29-8.87)	0.013	3.29 (1.24-8.73)	0.017	2.96 (1.10-7.92)	0.031
Tolerance^a								
Never	---		1 (ref)		1 (ref)		1 (ref)	
Rarely	---		1.31 (1.07-1.61)	0.010	1.31 (1.06-1.61)	0.012	1.28 (1.04-1.58)	0.019
Sometimes	---		2.21 (1.66-2.95)	<0.001	2.16 (1.62-2.88)	<0.001	2.09 (1.56-2.79)	<0.001
Often	---		3.06 (1.91-4.88)	<0.001	2.96 (1.85-4.75)	<0.001	2.80 (1.74-4.52)	<0.001
Almost always	---		3.95 (1.80-8.66)	0.001	3.92 (1.77-8.65)	0.001	3.98 (1.81-8.76)	0.001
Subjective socioeconomic status								
score	---		---		0.84 (0.80-0.89)	<0.001	0.84 (0.80-0.89)	<0.001
Smoking habit								
No	---		---		---		1 (ref)	
Yes	---		---		---		2.06 (1.40-3.03)	<0.001

Table 4: Adjusted odds ratios (ORs) for suicide risk in female participants with blind box engagement.

^a Tolerance (i.e., "Have you needed to buy blind boxes with larger amounts of money to get the same feeling of excitement in the past 12 months?").

the young population using large cross-sectional data while examining gender differences. Our results indicated that: 1) blind box engagement was associated with suicide risk. We postulate that the potential association between addiction, financial stress, mental health problems, and problem gambling may be the underlying reason behind blind box engagement's prediction of suicide risk.^{2,15} 2) there are gender differences in the association between blind box engagement and suicide

risk, which are reflected in the purchase behaviour and the number of buyers.

Since the blind box has the property of variable ratio reinforcement, buyers will gradually become addicted during the purchase process.²⁸ In addition, previous research accentuates that the meaning of "blind box" as a terminology has expanded from a commodity to a popular marketing strategy, which enhances consumers' addiction.³⁸ The blind box marketing strategy, in its

comprehensive yet succinct nature, attracts consumers in the following five aspects: 1) stimulus of uncertainty, 2) price attraction, 3) famous IPs (intellectual property), 4) hunger marketing, and 5) demands driven by social media. This study found that participants will have tolerance (i.e., one of the core symptoms of addiction) when purchasing blind boxes, which was associated with suicide risk across genders. Tolerance propels individuals to repeatedly purchase blind boxes, during which individuals' financial situation and mental health often worsen.²²

On the one hand, constant spending on blind boxes for excitement may induce financial stress for individuals. Our results showed that the frequency of male participants borrowing money or selling personal assets to gather funds for purchasing blind boxes could be associated with suicide risk. Nevertheless, future research needs to verify these findings by measuring the money expenditure, economic pressure, and debt of buying blind boxes. On the other hand, blind box engagement may be similar to gambling in nature, which increases suicide risk by inducing mental health problems such as anxiety and depression.²⁹ It is also worth noting that blind box engagement may also be a negative coping strategy for individuals already with mental health problems, which should be investigated by longitudinal research.

Blind box engagement may be associated with suicide risk through problem gambling. Gambling practices exist on a continuum from casual, recreational, problematic, and excessive gambling. Excessive gambling can lead to suicide.³⁹ We may infer that this is the same case for blind box engagement. In specific, results indicated that the relationship between blind box engagement and suicide risk is driven by over-engagement. The Chinese government has banned all gambling-related activities, except in Macau SAR (special administration region), which offers people limited gambling opportunities. In this case, it is reasonable to guess that blind box purchasing might be a surrogate activity because of their similarities. Given that the association between virtual video game loot boxes and problem gambling has been underlined^{19,40} and the fact that the boundary between blind boxes and virtual video game loot boxes (real and virtual) is becoming increasingly blurry, we expect that there is a correlation between blind boxes and problem gambling. Recently, a study of British adults suggested that virtual video game loot boxes may act as a gateway into gambling or problem gambling.⁴¹ Therefore, future research to investigate whether the blind box has such a "gateway effect," explore the path and mechanism of the blind box and suicide risk, and determine whether the blind box is associated with suicide risk through problem gambling.²

Previous studies have revealed the gender differences in gambling, marking its importance in

investigating the relationship between gambling and suicide risk.^{2,42} We also found that gender differences exist in blind box engagement. On the one hand, in the multivariable model, "Tolerance" and "Borrowed" were associated with male suicide risk, while only "Tolerance" was associated with female suicide risk. Previous research has shown that lenders will provide female borrowers with higher borrowing rates to get the same amount of money as their male counterparts.⁴³ In other words, compared to women, it is easier for men to borrow money from the credit market, so they have more funding to spend on blind boxes. More borrowing also puts more pressure on them to repay, leading to financial problems and borrowing-related interpersonal conflicts. This may be a plausible explanation for why "Borrowed" is associated with suicide risk in males but not females, as research has shown a link between financial-related problems and suicide among problem gamblers.⁴⁴ On the other hand, in contrast to traditional gambling, blind boxes attract more female participants.⁴² We think this is highly related to the content of the blind box. For example, the Molly series toys featured by POP MART (i.e., the industry-leading pop culture and art toy blind box enterprise in China) are tiny dolls featured with animated girl portrayals (i.e., exaggerated large eyes and pouting mouths) in different outfits, which are more visually appealing to female consumers.⁴⁵ We consider it is necessary to measure the types and motives of blind box engagement in the future to explore the underlying reasons given that female participants with blind box engagement have the highest suicide risk in this study. This also shows that the nature of blind box engagement is different from traditional gambling, which needs researchers' attention.

The primary limitation of this study lies in its cross-sectional nature, resulting in the inability of researchers to establish a cause-and-effect relationship. Blind box engagement may predict suicide risk, but suicidality may also predict engagement in behaviours with negative health and social consequences. Research has revealed a link between suicidality and externalising behaviours such as risk-taking (e.g., buying blind boxes). People's inability to endure distress may lead to avoiding discomfort through impulsiveness, risk-taking, substance use, or other maladaptive behaviours.⁴⁶ Future longitudinal research is needed to test the association between blind box engagement and suicide risk and to discern the direction of the causal relationship between blind box engagement and suicide risk. Second, due to convenient sampling, the results and findings from this study may not represent and generalise to the general youth population. Future research requires more replication studies from other populations to determine whether the observed effects would re-occur. Third, there may be a recall bias for the past behaviours and response bias due to fear of being

judged by financial situations and blind box engagement. Fourth, there are other variables influencing the association between blind boxes and suicide risk were not measured, such as personality characteristics. Evidence indicated that traits such as neuroticism, extroversion, impulsivity, and irritability might be possible markers of suicide risk.⁴⁷ Finally, It is also worth noting that future studies should develop a reliable and comprehensive measurement scale specifically for blind box engagement, focusing on addiction, economic stress, and psychological stress, to fill the gap in current literature. The development of measurement tools helps understand and study the blind box engagement better. Researchers can interview the groups who buy the blind box and those who do not buy the blind box to obtain more information. Some important questions need to be learned through interviews, including what motivation to buy a blind box, what impact the purchase of a blind box has on individuals, and what causes individuals to continue to buy. It is necessary to analyse the relationship between the blind box and other similar behaviours (e.g., gambling), which can better help researchers understand the similarities and differences between the blind box and other familiar behaviours and facilitate researchers' exploration of the theoretical level. Also, our results provide some preliminary findings that tolerance in blind box engagement can significantly predict the suicide risk of male and female participants. At the same time, tolerance is one of the core symptoms of addiction. Therefore, we think buying a blind box has the risk of addiction. Future research can consider addiction an essential direction when designing the scale and refer to other tools, including addiction content, such as the Problem Gambling Severity Index and the Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (DSM-V) diagnostic criteria of gambling disorder.

In conclusion, the dearth of research in this area necessitates the need to conduct further research to fill the gap in the literature and extend people's understanding of this emerging social phenomenon with potential harm. With continuously skyrocketing sales of blind boxes and its rising as a popular marketing strategy, the governance of an uprising industry does not match its fast-paced expansion, resulting in unregulated or under-regulated gaps. In the future, more in-depth investigations are needed to explore the internal relationship between blind box engagement, gambling, and suicide to assist policymakers in determining the appropriate degree of supervision, designing relevant regulations, and eventually ensuring both the healthy development of the blind box industry and youth's mental health.

Contributors

CRS, WYY, XSC and DYN were responsible for the conception, organisation, and execution of the study. XSC

and ZYW were responsible for the data collection. ZYW, DYN and WYZ were responsible for the statistical analysis and verification of the underlying data. DYN, WYZ were responsible for the manuscript preparation. WYY, CRS, XSC were responsible for the manuscript revision. CRS and WYY were responsible for project supervision. All authors had full access to all the data in the study and confirmed their responsibility for the decision to submit it for publication.

Data sharing statement

The dataset for this specific manuscript is available from the corresponding author upon request.

Declaration of interests

We declare no competing interests.

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:[10.1016/j.eclinm.2022.101575](https://doi.org/10.1016/j.eclinm.2022.101575).

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