



Associations of substance abuse histories and gambling addiction history with post-traumatic stress symptoms and depressive symptoms among Chinese prisoners

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ABSTRACT

Background: Although there are over two million prisoners in China, few studies have reported the prevalence and correlates of mental health problems in this population.

Objective: This study investigated the prevalence rates of trauma exposure, post-traumatic stress disorder (PTSD) and depression among Chinese male prisoners and further examined the associations of substance abuse histories and gambling addiction history with PTSD and depressive symptoms.

Method: Participants were 1,484 male prisoners (mean age 35.44 years, *sd* = 9.66) recruited from a large prison in Guangdong, China. Self-administered standardized questionnaires were used to assess trauma exposure, histories of substance abuse and perceived gambling addiction, social supports, childhood trauma, PTSD and depression. Criminal background information was extracted from jail record. Linear regressions were performed to examine the correlates of PTSD and depressive symptoms.

Results: Of these participants, 78.8% had experienced at least one trauma exposure, 26.7% had drug addiction, 85.5% had smoked cigarettes, 70.8% had used alcohol and 21.4% had gambling addiction before incarceration. The prevalence rates of PTSD and depression were 7.1% and 28.8%, respectively. Trauma exposure was significantly associated with PTSD and depressive symptoms, but not substance abuse histories and gambling history except for drinking. Histories of drinking and perceived gambling addiction were significantly related to PTSD and depressive symptoms after adjustment of demographics, criminal background, health status, social supports, childhood trauma and lifetime traumatic exposure.

Conclusions: Trauma exposure, PTSD and depression are common among prisoners. Furthermore, this study for the first time demonstrates a significant relationship between gambling addiction history and PTSD.

Asociaciones de antecedentes de abuso de sustancias e historial de adicción al juego con síntomas de estrés postraumático y síntomas depresivos entre los prisioneros chinos

Antecedentes: Aunque hay más de dos millones de presos en China, pocos estudios han informado la prevalencia y los correlatos de los problemas de salud mental en esta población.

Objetivo: Este estudio investigó las tasas de prevalencia de exposición al trauma, trastorno de estrés postraumático (TEPT) y depresión entre prisioneros chinos masculinos y examinó más a fondo las asociaciones de los antecedentes de abuso de sustancias y el historial de ludopatía con el TEPT y los síntomas depresivos.

Método: Los participantes fueron 1484 prisioneros varones (edad media 35,44 años, *dt* = 9,66) reclutados en una gran prisión de Guangdong, China. Se utilizaron cuestionarios estandarizados autoadministrados para evaluar la exposición al trauma, los antecedentes de abuso de sustancias y la percepción de adicción al juego, los apoyos sociales, el trauma infantil, el trastorno de estrés postraumático y la depresión. La información de antecedentes penales se extrajo del registro de la cárcel. Se realizaron regresiones lineales para examinar las correlaciones del TEPT y los síntomas depresivos.

Resultados: De estos participantes, el 78,8% había experimentado al menos una exposición a un trauma, el 26,7% tenía adicción a las drogas, el 85,5% había fumado cigarrillos, el 70,8% había consumido alcohol y el 21,4% tenía ludopatía antes del encarcelamiento. Las tasas de prevalencia de trastorno de estrés postraumático y depresión fueron de 7,1% y 28,8%, respectivamente. La exposición al trauma se asoció significativamente con el trastorno de estrés postraumático y los síntomas depresivos, pero no con los antecedentes de abuso de sustancias y los antecedentes de juego, excepto por el alcohol. Las historias de adicción al alcohol y al juego se relacionaron significativamente con el trastorno de estrés postraumático y los síntomas depresivos después del ajuste por datos demográficos, antecedentes penales, el estado de salud, los apoyos sociales, el trauma infantil y la exposición al trauma a lo largo de la vida.

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结论

犯人群体创伤暴露; 创伤后应激障碍和抑郁较为普遍。进一步, 本研究首次证实赌博成瘾史与创伤后应激障碍显著关联

HIGHLIGHTS

- Trauma exposure was common among Chinese prisoners.
- The prevalence rates of probable PTSD and depression were 7.1% and 28.8%, respectively.
- Histories of drinking and gambling addiction were associated with PTSD and depressive symptoms after adjustment of social supports, childhood trauma and lifetime traumatic exposure.

Conclusiones: La exposición a trauma, el trastorno de estrés postraumático y la depresión son comunes entre los presos. Además, este estudio demuestra por primera vez una relación significativa entre el historial de ludopatía y el trastorno de estrés postraumático.

背景: 尽管中国有超过200万在押服刑人员, 较少有研究报道该人群精神健康状况

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目的: 调查中国男性囚犯创伤暴露、创伤后应激障碍和抑郁的流行率状况, 进一步检查物质滥用史和赌博史与创伤后应激障碍症状和抑郁症状的关系。

方法: 对中国广东地区的一所大型监狱的1484名男性犯人(平均年龄35.44岁, 标准差9.66)进行问卷调查, 评估创伤暴露、物质滥用史、赌博成瘾史、社会支持、儿童期创伤、创伤后应激障碍症状和抑郁症状。犯罪背景信息来自监狱记录。线性回归用来考查创伤后应激障碍症状和抑郁症状的相关因素。

结果: 78.8%被试报告经历至少一次创伤事件。在入监复兴前, 有26.7%的犯人毒品成瘾, 85.5%抽烟, 70.8%喝酒, 21.4%赌博成瘾。创伤后应激障碍和抑郁的流行率分别为7.1%和28.8%。创伤暴露与创伤后应激障碍症状和抑郁症状显著相关, 与抽烟、赌博和毒品成瘾无关。调节人口学变量、犯罪背景、健康状况、社会支持、儿童期创伤和毕生创伤暴露后, 饮酒史和赌博成瘾史能显著预测创伤后应激障碍症状和抑郁症状。

结论: 犯人群体创伤暴露、创伤后应激障碍和抑郁较为普遍。进一步, 本研究首次证实赌博成瘾史与创伤后应激障碍显著关联。

1. Introduction

The world's imprisoned population has been growing during the past decades. In 2019, there were more than two million Chinese people imprisoned (<https://www.prisonstudies.org/>). Research has consistently shown that mental health disorders, such as substance misuse, post-traumatic stress disorder (PTSD) and major depression disorder, are highly overrepresented in prison populations (Fazel, Hayes, Bartellas, Clerici, & Trestman, 2016). For example, one meta-analysis study of 33,588 prisoners and more than 100 studies found that the prevalence of major depression was 11.4% (Fazel & Seewald, 2012). Another recent review of 21,099 imprisoned men and women from 20 countries reported that the prevalence of PTSD among male prisoners was 6.2%, and that of female prisoners was 21.1% (Baranyi, Cassidy, Fazel, Priebe, & Mundt, 2018). Psychiatric disorders within prison are associated with multiple kinds of adverse outcomes: mortality, suicide, self-harm, violence, and victimization (Favril, Yu, Hawton, & Fazel, 2020; Fazel et al., 2016). These conditions, in turn, would impair prisoners' social adaptation and further result in unemployment and reoffending after release from prison (Chang, Larsson, Lichtenstein, & Fazel, 2015). Although the psychiatric disorder burden of prisoners is substantial, the prevalence and risk factors of prisoners' PTSD and depression are rarely studied in low-income and middle-income countries, particularly in China (Baranyi et al., 2019).

Trauma exposure is a common problem in society, such as suffering from major disasters, serious accidents or violent attacks (Benjet et al., 2016). Several previous studies have indicated that trauma exposure is especially high in prisoners (Dudeck et al., 2011; Huang, Zhang, Momartin, Cao, & Zhao, 2006; Wolff & Shi, 2012). It is well known that trauma exposure is

associated with various physical and mental health problems (Geng, Liang, Shi, & Fan, 2018; Scott et al., 2013). A trauma-focused screen and intervention project would help to improve mental health care in prisons. However, there is only one study investigating the prevalence of trauma exposure and PTSD among Chinese prisoners (Huang et al., 2006). The study was conducted in 2004 and the sample was 471 female Chinese prisoners. Since trauma exposure is unevenly distributed in populations and varies according to time and regions, trauma and its related mental health problems should be further studied in Chinese prisoners.

Addictive behaviours are highly prevalent in prisoners worldwide (Fazel, Bains, & Doll, 2006): the estimates of prevalence for alcohol abuse and dependence in male prisoners ranged from 18% to 30% and in female prisoners ranged from 10% to 24%; the prevalence of drug abuse and dependence varied from 10% to 48% in male prisoners. The relationships between addictive behaviours and mental illness are complex. On the one hand, patients may use psychoactive substances (e.g. alcohol and tobacco) to relieve their suffering (Simpson, Stappenbeck, Luterek, Lehavot, & Kaysen, 2014); on the other hand, addictive behaviours may be important risk factors for psychiatric disorders. In China, smoking and drinking are prohibited while prisoners are in custody. Individuals with drug abuse need to be treated before being transferred to prison. Thus, current substance abuse would decrease to some degree. This provides an opportunity to examine whether the history of substance abuse is associated with current PTSD and depression.

Compared with substance abuse, the study on the relationship of gambling and psychiatric disorders is limited. Several studies have reported a high percentage of gambling addiction in patients with depression and PTSD (Grubbs, Chapman, & Shepherd, 2019; Schluter

et al., 2019). So far, there is only one cohort study that demonstrated past-year disordered gambling was associated with the subsequent occurrence of PTSD and any mood disorders in 33,231 American civilians aged 18 years or older (Chou & Afifi, 2011). To our best knowledge, the associations of gambling addiction history with PTSD and depressive symptoms have not been determined in prison. In addition, social support and trauma exposure are well-known predictive factors for both gambling and psychopathology (Dowling et al., 2017; Dussault et al., 2016), whether these common risk factors can fully account for the associations should be further explored.

In summary, the aims of this study were twofold: 1) to investigate the prevalence rates of traumatic exposure, probable PTSD (screened by self-reported scale), and depression among male prisoners in China; 2) to examine associations of histories of substance abuse and gambling addiction with PTSD and depressive symptoms after adjustment of lifetime trauma, childhood trauma, and social support.

2. Methods

2.1. Participants and procedures

Participants were recruited from a large male prison in Guangdong China. The sampling was described in detail in our previous study (Geng, Weng, et al., 2020). At the start of the survey, there were 2358 men incarcerated in the prison. Prisoners who were willing to participate in the study, had normal sight and completed at least primary school education were invited. Nevertheless, those under observation or diagnosed with serious mental illnesses were excluded from the study. Participants were measured in a group format using self-reporting questionnaires with help of five psychological professionals and one psychiatrist. In total, 1,708 questionnaires were distributed and 1508 usable ones were returned, giving a response rate of 88.3%. Of these participants, 1,484 completed questionnaires used in this study. The mean age of the participants was 35.44 (SD = 9.66), ranging from 18 to 69 years. Demographics and prison record data are presented in Table 1. The study was approved by South China Normal University. Licencing and support from prisons was also obtained. Written informed consent was obtained from all participants.

2.2. Measures

2.2.1. Demographic and background characteristics

Participants were asked to report their age, weight, height, highest level of education (less than high school/high school and above), marital status

Table 1. Sample characteristics ($n = 1484$).

	Mean	SD	Range
Age, year	35.44	9.66	18–69
BMI	22.33	2.72	14.69–32.05
Sentence length, month	70.19	43.43	7–174
Duration in prison, month	26.98	24.46	4–126
Childhood trauma	38.19	10.69	25–94
Perceived social support	55.94	12.28	12–84
	<i>n</i>	%	
Education			
Less than high school	1252	84.4	
High school and above	232	15.6	
Marital status			
Single	608	41.0	
Married	739	49.8	
Divorced or widowed	137	9.2	
Self-perceived physical health			
Poor	180	12.1	
Fair	838	56.5	
Good	466	31.4	
Violent offence			
Yes	505	34.0	
No	979	66.0	
First incarceration			
Yes	340	22.9	
No	1144	77.1	

(single/married/divorced or widowed), and perceived physical health (poor/fair/good). Offence type, history of imprisonment (yes/no), sentence length and duration in prison were collected from prison records. Offence type was recoded into violent (e.g. murder, manslaughter, and rape) vs. non-violent (e.g. drug offences, theft, and fraud) offences. The body mass index (BMI) was calculated by weight divided by the square of height.

2.2.2. Substance abuse histories and gambling addiction history

Participant's substance abuse histories and gambling addiction history were assessed by four items: (1) Before imprisonment, the number of cigarettes smoked per day?; (2) Before imprisonment, the frequency of alcohol consumption per week?; (3) Before imprisonment, have you taken illegal drugs? Yes/No; (4) Before imprisonment, were you addicted to gambling? Yes/No. Smoking history was categorized into no; 1–10 cigarettes per day; ≥ 11 cigarettes per day. Drinking history was grouped into no; 1–2 times per week; ≥ 3 times per week.

2.2.3. The patient health questionnaire – 9 (PHQ-9)

The PHQ-9 was used to assess depressive symptoms over the past 2 weeks (Kroenke, Spitzer, & Williams, 2001). It consists of nine questions corresponding to the diagnostic criteria for major depressive disorder covered by the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5). The rating of items is from 0 to 3. Scores can be summed and ranged from 0 to 27. A cut-off of 7 has been recommended in Chinese adults for screening clinical depression (Wang et al., 2014). The Cronbach's α was 0.88 with the current sample.

2.2.4. *The life events checklist (LEC)*

The LEC was used to assess trauma exposure during the whole lifetime (Gray, Litz, Hsu, & Lombardo, 2004). It is a self-report scale that assesses exposure to 17 potential traumatic events. Items are responded on a 6-point scale: 1 = happened to me; 2 = witnessed it; 3 = learned about it; 4 = part of my job; 5 = not sure; and 6 = does not apply. Participants indicated the status of their exposure, with the first four response categories counting as present. In the current study, a total score was calculated by counting the number of events the participants had been exposed to. Cronbach's α was 0.80 with the current sample.

2.2.5. *The post-traumatic stress disorder checklist for DSM-5 (PCL-5)*

The PCL-5 was used to assess PTSD symptoms in the past month (Blevins, Weathers, Davis, Witte, & Domino, 2015). It has 20 items covering four domains: re-experiencing, avoidance, negative changes in cognition and mood, and symptoms of hyper arousal. Respondents rated each item on a 5-point Likert scale, ranging from 0 ("not at all") to 4 ("extreme"). Possible diagnoses of PTSD were made according to DSM-5 diagnostic criteria: 1) items with a score of 2 or higher; 2) at least one re-experience, one avoidance, two negative cognitive and emotional changes, and two symptoms of hyperactivity. The Chinese version of PCL-5 has been shown good psychometric properties (Liu et al., 2014). The Cronbach value of the current sample was 0.94.

2.2.6. *Perceived social support scale (PSSS)*

The PSSS is constituted with 12 items to address relationships among social communication, surrounding environment and some directly related to perceived social support (Zimet, Dahlem, Zimet, & Farley, 1988). Each item is ranged from strongly disagree (1) to strongly agree (7). The participants select different scores for each question according to their current situation, and the range of score is from 12 to 84. The Cronbach's α was 0.91 with the current sample.

2.2.7. *The childhood trauma questionnaire-short form (CTQ-SF)*

The CTQ-SF is a 28-item self-reported questionnaire that assesses childhood traumatic experiences before age 18 years (Bernstein et al., 2003). This questionnaire includes 25 items used to evaluate five types of abuse: physical abuse (e.g. 'punished with hard objects'), emotional abuse (e.g. 'felt hated by family'), sexual abuse (e.g. 'made to do sexual things'), physical neglect (e.g. 'not enough to eat'), emotional neglect (e.g. 'felt loved'); and 3 validity items used for

effectiveness evaluation. Each item is scored on a 5-point Likert Scale: 1 = never; 2 = occasionally; 3 = sometimes; 4 = often; 5 = always. Scores can be ranged from 25 to 125. CTQ-SF has been proven to have good reliability and validity in clinical and community samples and has been revised and used all over the world. The Cronbach's α was 0.86 with the current sample.

2.3. *Data analyses*

Missing data were not replaced, and listwise deletion was used in the statistical analyses. Descriptive statistics were used to present sample characteristics and criminal data. Prevalence estimates of trauma exposure, PTSD, depression were presented with 95% confidence intervals, calculated using Wilson score interval. Trauma exposure and PTSD rates for specific traumatic events were calculated. Although the rates of trauma exposure increased when indirect exposure types were included, the main findings of this study were similar. According to DSM-5 traumatic event criteria, both direct and indirect exposure types were included for subsequent analyses. The chi-square test was used to examine the associations of trauma exposure (three categories: 0, 1–3, ≥ 4) with probable PTSD, depression, substance abuse histories, and perceived gambling addiction history. Effect sizes were measured using Cramer's V. Hierarchical linear regressions were performed to explore the associations between substance abuse histories, gambling addiction history and PTSD, depressive symptoms. PCL-5 and PHQ-9 total scores were modelled as continuous dependent variables. First, demographics, criminal variables, social support, childhood trauma, trauma exposure were entered into regression equations as covariates (step 1). Then, substance abuse histories and perceived gambling history were added (step 2). Variance inflation factor (VIF) statistics were used to detect collinearity, where a variable was considered to be highly multicollinear with other variables if the variance inflation factor was above 5 (O'Brien, 2007). VIF ranged from 1.060 to 2.972 in this study, indicating that multicollinearity was not an issue. R square changes in each step of the hierarchical regression analyses were reported. All analyses were performed using SPSS 16.0. Significance was set at $p < 0.05$ with two tails.

3. *Results*

In the sample, 39.6% [95%CI 37.2–42.1%] had experienced one to three traumatic events, and 39.2% [95% CI 36.7–41.7%] had experienced four or more traumatic events, when direct and indirect trauma exposure types were counted. The prevalence of specific

Table 2. Prevalence of trauma exposure and PTSD.

Event	Direct exposure		Direct and indirect exposure	
	Trauma exposure	PTSD	Trauma exposure	PTSD
	%[95%CI]	%[95%CI]	%[95%CI]	%[95%CI]
No event	38.3[35.9,40.8]	-	21.2[19.2,23.4]	-
Natural disaster	27.9[25.7,30.2]	8.7[6.3,11.8]	48.5[46.0,51.1]	8.9[7.0–11.2]
Fire or explosion	5.3[4.3,6.6]	15.2[8.9,24.7]	30.3[28.0,32.7]	10.4[7.9–13.6]
Transportation accident	20.2[18.3,22.3]	11.0[7.9,15.0]	51.2[48.7,53.8]	9.2[7.4–11.5]
Serious accident at work, home, or during recreational activity	4.5[3.6,5.7]	22.4[14.1,33.7]	18.8[16.9,20.9]	12.9[9.5,17.4]
Exposure to toxic substance	1.0[0.6,1.7]	13.3[3.7,37.9]	5.7[4.6,7.0]	11.9[6.6,20.5]
Physical assault	26.3[24.1,28.6]	12.1[9.2,15.7]	39.7[37.2,42.2]	11.2[8.9,14.0]
Assault with a weapon	11.4[9.9,13.1]	12.4[8.3,18.2]	21.7[19.7,23.9]	11.1[8.2,15.1]
Sexual assault	1.8[1.2,2.6]	15.4[6.2,33.5]	5.2[4.2,6.4]	11.7[6.3,20.8]
Other unwanted or uncomfortable sexual experience	2.1[1.5,3.0]	22.6[11.4,39.8]	4.5[3.6,5.7]	13.4[7.2,23.6]
Combat or exposure to a war zone	0.9[0.5,1.5]	7.7[1.4,33.3]	3.1[2.3,4.1]	8.7[3.4,20.3]
Captivity	2.6[1.9,3.5]	15.8[7.4,30.4]	5.1[4.1,6.4]	14.5[8.3,24.1]
Life threatening illness or injury	8.7[7.4,10.2]	17.8[12.2,25.3]	20.4[18.4,22.5]	14.2[10.7,18.6]
Severe human suffering	11.4[9.9,13.1]	20.1[14.8,26.8]	17.9[16.0,19.9]	17.4[13.3,22.4]
Sudden, violent death	1.1[0.7,1.7]	31.3[14.2,55.6]	9.9[8.5,11.5]	15.7[10.7,22.4]
Sudden, unexpected death of someone close to you	2.0[1.4,2.8]	37.9[22.7,56.0]	20.8[18.8,23.0]	13.3[9.9,17.5]
Serious injury, harm, or death you caused to someone else	10.4[8.9,12.0]	13.6[9.1,20.0]	12.6[11.0,14.4]	13.4[9.2,19.0]
Any other stressful event or experience	4.1[3.2,5.2]	26.2[16.8,38.4]	7.9[6.6,9.4]	22.2[15.6,30.6]
Any event	61.7[59.1,64.1]	9.7[8.0,11.8]	78.8[76.6,80.8]	9.0[7.5,10.8]

trauma types is presented in Table 2. Transportation accident, natural disaster, physical assault were the most common trauma types for direct exposure. Fire or explosion, assault with a weapon, and sudden death of someone close were also common when indirect exposure included.

The prevalence of PTSD was 7.1% [95% CI 5.9–8.5%] for the full sample and 9.0% [95% CI 7.5–10.8%] for trauma-exposed. Unwanted or uncomfortable sexual experience, severe human suffering, sudden violent death, and sudden death of someone close were associated with the highest risk of PTSD, see Table 2. The prevalence of depression was 28.8% [95% CI 26.6–31.2%]. Chi-square tests showed that the number of trauma exposure was significantly related to PTSD and depression, see Table 3.

Before imprisonment, 24.3% [95% CI 22.2–26.6%] participants reported they had smoked 1–10 cigarettes per day, and 61.2% [95% CI 58.7–63.6%] had smoked more than 10 cigarettes per day. With regard to drinking, 36.4% [95% CI 34.0–38.9%] had drunk 1–2 times per week, and 34.4% [95% CI 32.0–36.8%] had drunk over 2 times per week. Approximately 26.7% [95% CI

24.5–29.0%] participants had used illicit drug, and 21.4% [95% CI 19.4–23.5%] endorsed that they had been addicted to gambling. Chi-square tests indicated that there was no significant correlation between trauma exposure and histories of substance abuse and perceived gambling addiction. Although participants with smoking and drinking histories reported a high level of trauma exposure, the effect sizes were small.

Tables 4 and 5 display the results of hierarchical linear regressions for PTSD and depressive symptoms, respectively. As shown in Tables 4 and 5 step 1, self-perceived physical health, childhood trauma and lifetime trauma exposure significantly and positively associated with PTSD and depressive symptoms, while perceived social supports were significantly and negatively associated with PTSD and depressive symptoms. From step 1 to step 2, the r square changes were 0.017 and 0.019 for PTSD and depression, respectively. After adjustment of demographics, social supports, childhood trauma and lifetime trauma exposure, histories of severe drinking and perceived gambling addiction were significantly and positively associated with PTSD and depressive symptoms.

Table 3. Prevalence of PTSD, depression, substance use histories and gambling history by trauma exposures ($n = 1484$).

Variables	Total %	No. of trauma exposure			χ^2	p	Cramer's V
		No %	1–3%	$\geq 4\%$			
Total		21.2	39.6	39.2			
PTSD, yes	7.1	0	2.0	5.1	56.55	<.001	.137
Depression, yes	28.8	3.6	9.2	16.0	70.24	<.001	.188
Drug abuse history, yes	26.7	5.5	10.5	10.7	0.30	.747	.009
Smoking history					9.53	.049	.057
1–10 cigarettes per day	24.3	5.3	11.0	8.0			
≥ 11 cigarettes per day	61.2	12.9	23.5	24.7			
Drinking history					11.92	.018	.063
1–2 times per week	36.4	8.1	15.0	13.3			
≥ 3 times per week	34.4	6.2	12.7	15.4			
Perceived gambling addition history, yes	21.4	3.7	8.4	9.3	4.86	.088	.057

, $p < 0.01$; *, $p < 0.001$; PTSD = posttraumatic stress disorder.

Table 4. Hierarchical linear regressions for PTSD symptoms.

Variables	Step 1			Step 2		
	B (SE)	β	<i>p</i>	B (SE)	β	<i>p</i>
Age	0.06 (0.04)	.05	.101	0.09 (0.04)	.07	.028
BMI	0.14 (0.11)	.03	.180	0.11 (0.11)	.02	.308
Education	0.31 (0.83)	.01	.710	0.47 (0.83)	.01	.565
Marriage status						
Married	-1.25 (0.72)	-.05	.083	-1.23 (0.72)	-.05	.086
Divorced or widowed	1.24 (1.12)	.03	.266	1.28 (1.11)	.03	.249
Self-perceived physical health						
Fair	2.03 (0.64)	.08	.002	1.88 (0.64)	.08	.003
Poor	6.53 (0.99)	.17	<.001	6.17 (0.99)	.16	<.001
Sentence length	0.00 (0.01)	.00	.913	0.00 (0.01)	-.01	.904
Duration in prison	-0.02 (0.02)	-.04	.324	-0.02 (0.02)	-.04	.354
Violent offence	-0.34 (0.63)	-.01	.591	-0.08 (0.65)	-.00	.899
First incarceration	1.09 (0.69)	-.04	.113	1.61 (0.71)	-.05	.023
Social supports	-0.16 (0.03)	-.15	<.001	-0.15 (0.03)	-.15	<.001
Lifetime trauma exposure	1.29 (0.10)	.31	<.001	1.23 (0.10)	.30	<.001
Childhood trauma	0.21 (0.03)	.18	<.001	0.21 (0.03)	.18	<.001
Drug abuse history				0.53 (0.71)	.02	.450
Smoking history						
1–10 cigarettes per day				0.48 (0.99)	.02	.626
≥ 11 cigarettes per day				-0.16 (0.89)	-.01	.860
Drinking history						
1–2 times per week				0.55 (0.71)	.02	.440
≥ 3 times per week				2.28 (0.74)	.09	.002
Perceived gambling addiction history				3.01 (0.72)	.10	<.001
Model fit						
R square change	.248			.017		
χ^2 (df)	34.62 (14)			5.57 (6)		
<i>p</i>	<.001			<.001		

Table 5. Hierarchical regressions for depressive symptoms.

Variables	Step 1			Step 2		
	B (SE)	β	<i>p</i>	B (SE)	β	<i>p</i>
Age	-0.03 (0.02)	-.05	.123	-0.02 (0.02)	-.03	.0273
BMI	0.02 (0.05)	.01	.733	-0.00 (0.05)	-.00	.924
Education	0.64 (0.35)	.05	.069	0.72 (0.35)	.05	.043
Marriage status						
Married	-0.06 (0.31)	-.01	.855	-0.05 (0.31)	-.01	.874
Divorced or widowed	0.57 (0.48)	.03	.231	0.59 (0.47)	.03	.216
Self-perceived physical health						
Fair	1.13 (0.27)	.11	<.001	1.03 (0.27)	.10	<.001
Poor	4.01 (0.42)	.26	<.001	3.79 (0.42)	.24	<.001
Sentence length	0.00 (0.01)	.01	.723	0.00 (0.01)	.00	.938
Duration in prison	-0.01 (0.01)	-.02	.559	-0.00 (0.01)	-.02	.654
Violent offence	0.03 (0.27)	.00	.906	0.14 (0.28)	.01	.624
First incarceration	-0.28 (0.29)	.02	.347	0.05(0.30)	.00	.872
Social supports	-0.06 (0.01)	-.13	<.001	-0.05 (0.01)	-.12	<.001
Lifetime trauma exposure	0.37 (0.04)	.22	<.001	0.35 (0.04)	.20	<.001
Childhood trauma	0.07 (0.01)	.15	<.001	0.07 (0.01)	.15	<.001
Drug abuse history				0.16 (0.30)	.01	.549
Smoking history						
1–10 cigarettes per day				-0.04 (0.42)	-.00	.916
≥ 11 cigarettes per day				0.03 (0.38)	.00	.936
Drinking history						
1–2 times per week				-0.06 (0.30)	-.01	.850
≥ 3 times per week				0.75 (0.31)	.07	.017
Perceived gambling addiction history				1.38 (0.31)	.11	<.001
Model fit						
R square change	.203			.019		
χ^2 (df)	26.77 (14)			5.91 (6)		
<i>p</i>	<.001			<.001		

4. Discussion

This is the first study on the prevalence of PTSD and depression among male prisoners in mainland China. The lifetime trauma exposure, PTSD, and depressive symptoms were common among prisoners. Furthermore, our study for the first time indicated

that gambling addiction history was significantly associated with PTSD and depressive symptoms among Chinese prisoners, even after adjustment of social supports, childhood trauma, and lifetime trauma exposure.

In the present sample, a majority of male prisoners (79.8%) responded as having at least one

traumatic event, compared with 71.9% of the general Chinese male population surveyed recently by our group (Geng, Li, et al., 2020). The prevalence of trauma exposure is also a little higher than that reported in the Hong Kong survey of general population (Wu et al., 2019). Similar to the reports of general population (Benjet et al., 2016; Geng, Li, et al., 2020; Wu et al., 2019), the most reported trauma types were transportation accident and natural disasters. However, it should be noted that the proportions of severe human suffering, assault with a weapon, and physical assault were relatively high in prisoners. Consistent with previous studies (Amstadter, Aggen, Knudsen, Reichborn-Kjennerud, & Kendler, 2013; Dudeck et al., 2011; Wolff & Shi, 2012), the number of trauma exposure was positively related to PTSD and depression symptoms, as well as drinking and smoking history. Notably, nearly 40% of responders reported that they had experienced more than three traumatic events. It is well known that cumulative trauma is associated with more severity of physical and mental health problems and less life satisfaction (Karam et al., 2014; Sacchi, Merzhvynska, & Augsburg, 2020). This would be a challenge for mental health service in the criminal justice system.

This study found that the prevalence of PTSD was 7.1%, which is similar to that estimated by one meta-analysis study of prisoners (Baranyi et al., 2018). Compare prevalence with different areas in prisoners, the figure reported in this study is higher than that of a large sample in Taiwan (Tung, Hsiao, Shen, & Huang, 2019) and lower than those reported in Canada (Beaudette & Stewart, 2016) and New Zealand (Favril, Indig, Gear, & Wilhelm, 2020). In a representative sample of Chinese adults, one study reported that the prevalence of PTSD in general population was 0.2%-0.5% (Huang et al., 2019). In a sample of 7218 Chinese community adults, the prevalence of PTSD was 2.1% (Geng, Li, et al., 2020). In spite of different samples, instruments, and assessment methods, it can be conservatively estimated that PTSD in prison would be at least three times higher than in the general population. Accordingly, the prevalence of depression is also higher than that reported in general population (Fazel & Seewald, 2012). Since most prisoners will be released into society, it is a golden opportunity to identify and intervene in these emotional problems, as the disease burden is substantially high.

Most of our participants had a history of substance abuse before they went to prison: 26.7% of them had a history of drug abuse; 70.8% of them had a history of drinking; as high as 85.5% of them had a history of smoking. In this research, the association between smoking and PTSD and depression is not significant, the main reason is 85.5% of participants had a history of smoking, which may cause the ceiling effect. As expected (Conner, Pinquart, &

Holbrook, 2008; Dworkin, Wanklyn, Stasiewicz, & Coffey, 2018), drug abuse history was associated with PTSD and depression (standardized $\beta = 0.07$ for both PTSD and depression, $p < 0.01$). However, the association is no longer significant after controlling for demographics, social support, childhood trauma, lifetime trauma, and other addictive behaviours. The possible reason is that these variables mediated the relationship of drug abuse and PTSD and depression. Drinking history is also significantly related to PTSD and depressive symptoms in this study, which is analogous to previous studies (Kaysen et al., 2011; McCarthy & Petrakis, 2010). Possible mechanisms of this significant association are complex. Trauma exposure is related to both drinking and PTSD, which can partially explain the relationship of drinking history and PTSD. Patients with PTSD might use alcohol to manage their symptoms (self-medication model). However, concurrent drinking status and PTSD history were not measured in this study, the hypothesis cannot be tested. In addition, psychological factors, such as coping and drinking motives, may play a role in the pathways between drinking and PTSD (Simpson et al., 2014), which cannot be ignored.

Extending previous study on associations of gambling disorders and mental disorders in the American general population (Chou & Afifi, 2011), our findings for the first time showed that Chinese male prisoners with a history of gambling addiction reported more symptoms of PTSD and depression. Furthermore, after controlling for childhood trauma, lifetime trauma, social support and substance abuse, which are common risk factors for both gambling and PTSD and depression, the relationships were still significant. There are some possible explanations for the strong connection of gambling addiction history and PTSD and depression. First, from the perspective of heritability, the correlation between gambling and PTSD and depressive symptoms may be influenced by overlapping genetic factors. One study found that there was a substantial correlation between the genetic components of pathological gambling and major depression ($r = 0.58$), with 34% of the genetic variance for each disorder also contributing to that of the other (Potenza, Xian, Shah, Scherrer, & Eisen, 2005). However, the specific genetic risk factors common to both gambling addiction and PTSD have yet been studied. The polymorphisms of the dopamine transporter gene and serotonergic receptor gene would be important candidate genes (Potenza et al., 2019). Second, gambling addiction usually causes personal financial crisis and destroys their social support system, which may mediate gambling addiction history and emotional problems. Third, several studies have indicated that gambling addiction and PTSD might have common abnormalities in brain structure and

function. For example, both these conditions were related to small hippocampus and impairment of amygdala function (Potenza et al., 2019; Yehuda et al., 2015). Future studies can examine this hypothesis directly by including both disease in one study. Besides, personality traits, emotional regulation abilities, and gambling-related cognitions might moderate and mediate the link between gambling and PTSD (Grubbs et al., 2019).

Though the relatively large sample, detailed assessments of trauma and social support and inclusion of individuals from different backgrounds and age groups were strengths of this study, there are several limitations. Participants were a convenient sample of male prisoners, so it must be cautious to generalize the conclusions to female prisoners. The findings were based on self-reported questionnaires rather than validated diagnostic instruments, especially gambling addiction history was measured by one item, self-report biases and recall biases cannot be avoided. In addition, this is a cross-sectional study. Although substance misuse histories and gambling addiction history may implicate causal relationship and concurrent substance use and gambling were controlled, longitudinal studies are needed to replicate our findings and further examine the mediators and moderators between gambling history and current mental health. Finally, imprisonment itself might be a traumatic event and traumatic events that occurred in prison might also contribute to prisoners' mental health problems (Fjeldsted, Teasdale, Jensen, & Erlangsen, 2017; Piper & Berle, 2019). Studies including controls and measuring of trauma in prison are needed to examine the influences of these traumatic events.

Findings from the current research have important clinical implications. Trauma exposure is common in prison and associated with increased mental health problems. Notably, severe human suffering, assault with a weapon, and physical assault are substantially high among prisoners. Except for existing trauma, prisoners are also prone to traumatic experiences in prison. Various traumatic events (e.g. childhood trauma, life-threatening events, and daily stressors) would be considered when screening trauma-related disorders and delivering trauma-based treatments. Substance abuse and gambling behaviours are also popular among prisoners, which may lead to long-term adverse effects on PTSD and depression. Our study demonstrated that using several items with little time cost can be effective to screen these unhealthy lifestyles and indicate possible detrimental outcomes. This assessment strategy should be integrated into routine management in prison. Finally, recognition of the association between gambling addiction history and PTSD may inform targeted prevention efforts that aim to reduce onset of mental health problems in prison. It remains unclear whether treatment of

addictive behaviours is protective against PTSD and other disorders, a question that is an important topic for future study.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author, Fulei Geng. The data are not publicly available due to their containment of information that could compromise the privacy of research participants.

Disclosure statement

No potential conflict of interest was reported by the authors.

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