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Potential risk factors for methamphetamine use among inmates in a Japanese prison

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Abstract

Background In Japan, drug addiction recovery guidance and social reintegration programs are implemented for eligible inmates in many prisons. However, methamphetamine addiction, especially among those with a history of thinner inhalation, often seems not to be adequately addressed in addiction treatment programs. The comorbidities of substance use disorders may be generally overlooked. This study aimed to provide valuable data for guiding the development of programs to combat drug addiction and support social reintegration for inmates. The first step of this study sought to determine the association between history of daily/regular methamphetamine use and use of other substances as well as the relationship between methamphetamine use and sociodemographic background.

Methods This retrospective study included 470 consecutive inmates whose data were obtained and who consulted a certified psychiatrist. Chi-square tests and paired t-tests were used for the analysis. Furthermore, a multinominal regression analysis was performed.

Results Our findings revealed that the history of daily/regular methamphetamine use was significantly associated with the history of psychiatric consultation, sexually transmitted infections, daily/regular thinner inhalation, and daily/regularly tobacco smoking. Moreover, daily/regular thinner inhalation was initiated at a significantly younger age than methamphetamine use. In addition, tobacco smoking was initiated at a significantly younger age than methamphetamine use.

Conclusion The present study suggested that a history of daily/regular thinner inhalation and daily/regular tobacco smoking may serve as potential risk factors for the development of daily/regular methamphetamine use. Furthermore, these findings highlight the significant association between thinner or nicotine addiction and subsequent methamphetamine addiction. These results may provide valuable insights for supporting and protecting inmates with methamphetamine addiction as well as individuals at risk.

Trial registration Not applicable.

Keywords Methamphetamine, Pathway, Causality, Strength, Temporality, Inmates, Prison, Japan

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Background

Methamphetamine abuse has been widely reported to cause neurological damage, leading to mental disorders, physical diseases, and cognitive dysfunction [1]. While some pharmacological treatments for methamphetamine-induced disorders have been explored, further clinical studies are needed [2]. Alternatively, psychological treatments for psychiatric symptoms associated with methamphetamine use have shown overall effectiveness [3].

However, due to the wide range of psychiatric disorders associated with methamphetamine-induced neurological damage, treatment strategies remain insufficiently explored. Moreover, distinguishing between persistent methamphetamine-associated psychosis and schizophrenia based on behaviors and symptoms is particularly challenging [4]. Furthermore, comorbid psychiatric diseases complicate the treatment of illicit methamphetamine users [5]. Akindipe et al. showed that methamphetamine dependence is associated with mood, psychotic, and anxiety disorders, which can be classified into primary and substance-induced patterns, except for substance-induced anxiety disorder [5]. Earlier initiation and prolonged methamphetamine use have also been associated with a higher risk of psychosis [6]. Another study reported that the severity of psychotic and depressive symptoms in methamphetamine users, including the number of suicide attempts, correlated with the amount of methamphetamine used [7].

While numerous studies have reported the adverse events and comorbidities of methamphetamine addiction, fewer have examined the reasons for its use. Some individuals turn to methamphetamine for self-medication to alleviate emotional distress [8, 9]. Brecht et al. analyzed drug initiation sequences in individuals seeking treatment for methamphetamine use and found that alcohol, marijuana, and tobacco use often preceded methamphetamine use [10]. The authors also reported that approximately one-third of methamphetamine users did not complete high school [10]. Another study also reported that methamphetamine-using felons exhibited psychosocial and behavioral characteristics [11]. The subjects included in the aforementioned study, which aimed to help reduce HIV/AIDS transmission by investigating methamphetamine user patterns, motivations, social networks, and risk behaviors, were recruited using posters and media campaigns, agencies, etc [11].

Some reasons for initiating methamphetamine use include performance enhancement, coping with personal challenges, and increasing sexual performance and impulse control. Given these factors, prevention programs, withdrawal support, and education on methamphetamine's harmful effects are of paramount significance [8]. However, achieving these goals is particularly challenging due to the high recidivism rates among methamphetamine users, highlighting the need for appropriate interventions that address the root causes of addiction and repeated offenses [12]. Hence, analyzing data from incarcerated individuals may provide valuable insights into these factors. To the best of our knowledge, no previous study has explored the pathways leading to methamphetamine use, by examining multiple factors, including sociodemographic characteristics, specifically among incarcerated individuals. In line with this, the present study aimed to determine the association between the history of the daily or regular use of methamphetamine and use of other substances as well as the association between methamphetamine abuse and sociographic background. In Japan, many prisons seem to offer drug addiction recovery guidance and social reintegration programs for eligible inmates. However, comorbid substance addictions, such as history of thinner inhalation alongside methamphetamine use, seem to be often overlooked in addiction treatment programs. Therefore, this study aimed to focus on this particular issue and offer insights that may improve the prevention and treatment of methamphetamine addiction, ultimately supporting inmates and individuals at risk.

Methods

Subjects

Our study included 470 consecutive inmates whose data were obtained and who subsequently consulted a certified psychiatrist between March 2022 and January 2024 at the medical office of a prison in Japan (name withheld). Sampling was rational and not arbitrary, and only data obtained during this period were analyzed.

This retrospective study used data from medical records based on routine intake questionnaires completed at prison admission and in the first psychiatric examination. These data might be valuable for planning drug addiction recovery programs for inmates struggling with stimulants or other substance addictions. In addition, these data could play a crucial role in developing social reintegration programs aimed at preventing recidivism. Both addiction recovery and social reintegration programs aim to reduce repeat offenses.

Variables

This study analyzed the following variables: age, educational background, history of psychiatric consultation, history of psychiatric hospital admission, history of sexually transmitted infections, history of daily/regular methamphetamine use (average initiation age), history of daily/regular thinner inhalation (average initiation age), history of daily/regular alcohol consumption (average initiation age), and history of daily/regular tobacco smoking (average initiation age). Analyzing these factors may

provide key insights for the recidivism prevention plan among inmates in Japan.

Statistical analysis

All analyses were conducted using JMP 8 (SAS Institute Inc., Cary, NC, USA). Chi-square test was used to assess the association between the history of daily/regular methamphetamine use and other variables. A paired t-test was used to determine whether a significant difference existed between initiation ages of methamphetamine and other substances, in addition to identifying any significant associations. A multinomial regression analysis ($n = 459$) was performed, adjusting for potential confounding factors, to more accurately evaluate the independent relationships between methamphetamine use and other variables. A p-value of < 0.05 was considered statistically significant.

Results

Demographic data are summarized in Table 1, with the right-most column displaying the number of subjects for each variable. The results of the association between the history of daily/regular methamphetamine use and other variables, including history of psychiatric consultation, history of psychiatric hospital admission, history of sexually transmitted infections, history of daily/regular thinner inhalation, history of daily/regular alcohol consumption, and history of daily/regular tobacco smoking, are detailed in Table 2. The association between the history of daily/regular methamphetamine use and educational background is presented in Table 3. Notably, Table 2 indicates that the history of daily/regular methamphetamine use was significantly associated with the history of psychiatric consultation, history of sexually transmitted infections, history of daily/regular thinner inhalation, and history of daily/regular tobacco smoking. Moreover, Table 3 shows that a lower educational background was significantly associated with a history of daily/regular methamphetamine use.

Table 1 presents the "initiation age" for daily/regular methamphetamine use, daily/regular thinner inhalation, daily/regular alcohol consumption, and daily/regular tobacco smoking. To explore the temporality of these associations, we compared the initiation ages of daily/regular methamphetamine use, daily/regular thinner inhalation, and daily/regular tobacco smoking using the paired t-test, with results shown in Table 4. The temporality is important for investigating risk factors [13]. Notably, the initiation age for methamphetamine use was significantly higher than that for thinner inhalation and tobacco smoking.

The results of the multinomial regression analysis were as follows: when the history of daily/regular methamphetamine use was used as an independent variable, the

Table 1 Social background and history of substance addiction, including initiation age

		Sample size
Age (years), average ± s.d.	45.3 ± 12.0	470
Sex	Male	470
	Female	0
Educational background	JH: 315 (68.2%)	462
	SH: 122 (26.4%)	
	UNI: 25 (5.4%)	
History of psychiatric consultation	No: 58 (12.4%)	469
	Yes: 411 (87.7%)	
History of psychiatric hospital admission	No: 276 (59.5%)	464
	Yes: 188 (40.5%)	
History of sexually transmitted infections	No: 380 (80.9%)	470
	Yes: 90 (19.1%)	
History of daily/regular methamphetamine use	No: 216 (46.0%)	470
	Yes: 254 (54.0%)	
Average initiation age (years) ± s.d.	22.2 ± 7.1	251
History of daily/regular thinner inhalation	No: 277 (59.0%)	470
	Yes: 193 (41.0%)	
Average initiation age (years) ± s.d.	14.6 ± 2.0	192
History of daily/regular alcohol consumption	No: 104 (22.1%)	470
	Yes: 366 (77.9%)	
Average initiation age (years) ± s.d.	18.4 ± 5.3	360
History of daily/regular tobacco smoking	No: 59 (12.6%)	469
	Yes: 410 (87.4%)	
Average initiation age (years) ± s.d.	15.6 ± 3.9	410

Abbreviations: JH, junior high school; SH, senior high school; UNI, university or higher

Table 2 Chi-square test results for the association between history of daily/regular methamphetamine use and various factors

		MH		χ^2 (1) = *P*-value Likelihood ratio test Pearson test	Sample size
		No	Yes		
PC	No	37 (7.9%)	21 (4.5%)	0.0037* 0.0038*	469 (100%)
	Yes	179 (38.2%)	232 (49.5%)		
PA	No	126 (27.2%)	150 (32.3%)	0.9843 0.9843	464 (100%)
	Yes	86 (18.5%)	102 (22.0%)		
STI	No	187 (40.0%)	193 (41.1%)	0.0033* 0.0036*	470 (100%)
	Yes	29 (6.2%)	61 (13.0%)		
TI	No	191 (40.6%)	86 (18.3%)	< 0.0001** < 0.0001**	470 (100%)
	Yes	25 (5.3%)	168 (35.7%)		
AC	No	46 (9.8%)	58 (12.3%)	0.6886 0.6889	470 (100%)
	Yes	170 (36.2%)	196 (41.7%)		
TBS	No	47 (10.0%)	12 (2.6%)	< 0.0001** < 0.0001**	469 (100%)
	Yes	168 (35.8%)	242 (51.6%)		

p-value: * <0.01, ** <0.001

Abbreviations: MH, history of daily/regular methamphetamine use; PC, history of psychiatric consultation; PA, history of psychiatric hospital admission; STI, history of sexually transmitted infections; TI, history of daily/regular thinner inhalation; AC, history of daily/regular alcohol consumption; TBS, history of daily/regular tobacco smoking

Table 3 Chi-square test results for the association between educational background and history of daily/regular methamphetamine use

		Educational background			Sample size
		Junior high school	Senior high school	At least university	
MH	No	110 (23.8%)	79 (17.1%)	21 (4.6%)	462 (100%)
	Yes	205 (44.4%)	43 (9.3%)	4 (0.9%)	

χ^2 (2) = P-value

Likelihood ratio test: <0.0001, Pearson test: <0.0001

MH, history of daily/regular methamphetamine use

p-values (from the likelihood radio test for each dependent variable) were 0.162 for educational background, 0.037 for history of psychiatric consultation, 0.438 for history of psychiatric hospital admission, 0.013 for history of sexually transmitted infections, < 0.0001 for history of daily/regular thinner inhalation, 0.038 for history of daily/regular alcohol consumption, and 0.0005 for history of daily/regular tobacco smoking.

Discussion

To the best of our knowledge, this is the first study to investigate the association between daily /regular methamphetamine use and a range of social, medical, and addictive factors among inmates who consulted a certified psychiatrist in a prison. The results of the chi-square and paired t-tests were largely consistent with those of the multinomial regression analysis. However, in the multinomial regression analysis, educational background was not significantly associated with the history of daily/regular methamphetamine use. These results have important implications for preventing the initiation of methamphetamine use. However, it is essential to note that while this study establishes a chronological order using temporality, it does not confirm causality.

A significant association was observed between the history of daily/regular methamphetamine use and the

Table 4 Paired t-test results for the initiation age of various substances

Paired t-test for initiation age Between	Sample size	Average age of initiation (years)	Average difference ± Standard error	*P*-value (Prob >| t|)
Thinner and Methamphetamine	167	Thinner: 14.6 Methamphetamine: 21.1	−6.5 ± 0.5	< 0.0001**
Smoking and Methamphetamine	239	Smoking: 14.7 Methamphetamine: 22.1	−7.4 ± 0.5	< 0.0001**
Smoking and Thinner	185	Smoking: 14.3 Thinner: 14.6	−0.3 ± 0.2	0.1391

p-value: ** < 0.001

history of psychiatric consultation (Table 2). Conversely, no significant association was found between the history of daily/regular methamphetamine use and the history of psychiatric hospital admission (Table 2). This suggests that individuals who regularly use methamphetamine exhibit psychiatric disorders that are not severe enough to require hospitalization. Previous studies have primarily focused on methamphetamine addiction in psychiatric inpatients [5, 6, 10, 14] and outpatients [5, 7, 15]. The present findings raise questions about the necessity of hospital treatment for methamphetamine addiction. Instead, our results suggest that inmates with a history of methamphetamine use may develop mild-to-moderate psychiatric disorders, leading them to seek psychiatric consultation. Although specific psychiatric disorders were not investigated in the present study, methamphetamine use has been linked to benzodiazepine abuse. In Japan, psychiatric disorders induced by methamphetamine are among the most common reasons for psychiatrist consultations by illicit drug users [16]. In turn, this suggests that some patients with a history of methamphetamine use may seek psychiatric care to obtain benzodiazepine prescriptions. Moreover, amphetamines, which share pharmacological properties with methamphetamines, are considered among the most harmful substances to both users and society [17]. This could be linked to criminal behavior.

A significant association was also found between the history of daily/regular methamphetamine use and the history of sexually transmitted infections (Table 2). However, while the average initiation age (years) for methamphetamine use was 22.2 ± 7.1 years, data on the initiation age for sexually transmitted infections were unavailable (Table 1). Therefore, a direct association between the two could not be inferred. Previous research has linked the use of chemsex drugs to behaviors that increase the risk of sexually transmitted infections, particularly among men who have sex with men [18]. However, due to the lack of data on sexual orientation in this study, further investigation is needed.

Another significant association was observed between the history of daily/regular methamphetamine use and the history of daily/regular thinner inhalation (Table 2). In addition, daily/regular thinner inhalation was initiated at a significantly younger age than daily/regular methamphetamine use (Table 4). While this finding does not establish a causal relationship between thinner abuse and subsequent methamphetamine abuse, Tables 2 and 4 highlight the strength and temporality of the association, respectively [13]. Thinners, primarily composed of mixed organic solvents like toluene, can be classified into various types. The inhalation of toluene, which is commonly used by children and adolescents for its intoxicating effects, is an important public health concern [19]. Adolescent toluene abuse has been shown to affect specific neural pathways in the medial prefrontal cortex of the brain, which may contribute to future substance abuse [20].

Similarly, a significant association was observed between the history of daily/regular methamphetamine use and the history of daily/regular tobacco smoking (Table 2). Moreover, daily/regular tobacco use was initiated at a significantly younger age than daily/regular methamphetamine use. Again, while this finding does not establish a causal relationship between tobacco smoking and subsequent methamphetamine use, Tables 2 and 4 demonstrate the strength and temporality of the relationship, respectively [13]. Also, prior research suggests that tobacco use may precede methamphetamine use, either directly or through the use of other substances [10]. Interestingly, no significant association was observed between daily/regular methamphetamine use and daily/regular alcohol consumption (Table 2). While substances like marijuana and alcohol influence different neurotransmitter systems, they both reinforce the dopaminergic pathway via the mesolimbic system [21]. Nicotine exposure during adolescence has been linked to

increased susceptibility to drug abuse, with nicotine and methamphetamine often being used together [22].

The present study also found that a low educational background was significantly associated with daily/regular methamphetamine use (Table 3), aligning with the results of a previous study [10]. However, in the multinomial regression analysis, this association was not significant, highlighting a key nuance in the findings. Notably, the initiation age (years) for daily/regular methamphetamine use was 22.1 ± 7.1 years, which was much older than the typical junior high school graduation age (15 years). This suggests that educational background influences methamphetamine use temporally rather than causally [13].

The findings of the present study provide novel and valuable insights for developing strategies to prevent methamphetamine abuse and addiction. This research was inspired by real-world observations, followed by a review of existing literature, which revealed a lack of sufficient data. As a result, we conducted this study using available information. A key finding of the present study is that habitual tobacco smoking and/or thinner inhalation during childhood is associated with habitual methamphetamine use in young adulthood. Addressing this issue may require improvements in education and stronger regulations against thinner inhalation and tobacco smoking. However, such interventions may be challenging to implement, as they would require broader social and structural changes. On the other hand, addiction treatment in correctional facilities must integrate conventional programs into a newly developed hybrid system, considering the findings of this study. Regarding drug addiction treatment in correctional facilities, the current system in Japan seems to rely on two main approaches: First, incarceration prevents inmates from using methamphetamine during their sentence. Second, rehabilitation programs used in general society are also applied within correctional facilities. However, these methods alone have proven insufficient, as recidivism rates for methamphetamine abuse remain high. The findings of the present study suggest the need for a third approach: considering inmates' history of daily/regular thinner inhalation and daily/regular tobacco smoking. Therefore, social reintegration is needed while developing rehabilitation strategies. A more comprehensive reintegration plan should incorporate these factors, ensuring that post-release support for individuals with methamphetamine addiction addresses comorbid substance abuse.

The present study had several limitations. First, most data used in this study were collected through self-reported interviews, which may have affected reliability and limited the ability to establish causality. Second, this study could not precisely determine the duration or patterns of substance abuse. Third, only a limited range of sociodemographic data was collected; for example, information on family background, criminal records, previous occupations, and types of crime committed was unavailable due to confidentiality concerns. Fourth, the present study focused exclusively on male inmates in a single prison, potentially introducing selection bias. Finally, potential confounding factors were not fully considered. Future research should aim to address these limitations by collecting more detailed data.

Despite these limitations, the present study had some strengths. It highlighted the potential for integrating methamphetamine addiction treatment with interventions for thinner inhalation and nicotine dependence. However, methodological improvements are necessary for future research to strengthen these findings.

Conclusion

The history of daily/regular thinner inhalation and the history of daily/regular tobacco smoking may be potential risk factors for daily/regular methamphetamine use. Moreover, our findings revealed an association between early thinner or nicotine addiction and subsequent methamphetamine addiction. The findings of this study can aid in the development of strategies for supporting and protecting both inmates struggling with methamphetamine addiction and individuals at risk of developing such dependencies.

Abbreviations

AC	History of daily/regular alcohol consumption
JH	Junior high school
MH	History of daily/regular methamphetamine use
PA	History of psychiatric hospital admission
PC	History of psychiatric consultation
SH	Senior high school
STI	History of sexually transmitted infections
TI	History of daily/regular thinner inhalation
TBS	History of daily/regular tobacco smoking
UNI	University or more

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Author contributions

MT wrote the main manuscript text and all the Tables. KT provided very useful comments as a psychiatrist. TK provided very important and useful comment as a specialist of correctional medicine.

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Data availability

The datasets generated and/or analyzed during the present study are available from the corresponding author upon reasonable request.

Declarations

Ethical approval and consent to participate
The current study adhered to the Declaration of Helsinki and was approved by Ethics Review Committee of Correctional Medicine Academic Research Council, established by the Correction Bureau, Ministry of Justice of Japan. The requirement for informed consent was waived by the same committee.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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