



Psychiatric Complications in Adolescent Methamphetamine Use in Pakistan: A Case Series

Uzma Amin, Arooj Arshad & Muhammad Meesam Siddique

To cite this article: Uzma Amin, Arooj Arshad & Muhammad Meesam Siddique (27 Jan 2025): Psychiatric Complications in Adolescent Methamphetamine Use in Pakistan: A Case Series, Journal of Child & Adolescent Substance Use, DOI: [10.1080/29973368.2025.2453212](https://doi.org/10.1080/29973368.2025.2453212)

To link to this article: <https://doi.org/10.1080/29973368.2025.2453212>



Published online: 27 Jan 2025.



Submit your article to this journal [↗](#)




View related articles [↗](#)



View Crossmark data [↗](#)



Psychiatric Complications in Adolescent Methamphetamine Use in Pakistan: A Case Series

Uzma Amin^a , Arooj Arshad^b and Muhammad Meesam Siddique^a

^aGovt Drug Rehabilitation Center, Social Welfare & Bait ul Maal Department, Punjab, Pakistan; ^bRIPHAH Institute of Clinical and Professional Psychology, Multan, Pakistan

ABSTRACT

Methamphetamine use has become an epidemic among Pakistani youth in education institutions and communities and has adverse short-term and long-term effects on individuals. The present case series is a qualitative exploration of psychiatric complications in adolescent methamphetamine use in Pakistan. Interviews were transcribed verbatim, manually analyzed within cases and across cases with major themes, interpreted, and independently cross-checked for context and accuracy. Results revealed that psychosis, self-harm, suicidality, aggression, and insomnia are major psychiatric complications among adolescents using methamphetamine. This qualitative case series suggests that evaluating for psychiatric complications of methamphetamine use should be incorporated into treatment.

KEYWORDS

mental health;
methamphetamine;
substance-induced psychosis;
well-being

Introduction

Substance use in Pakistan, particularly among youth, has been rising (Abbasi, 2016). Reports indicate that 700 individuals die daily of drug-related causes, a figure that surpasses deaths from terrorism in Pakistan (Dawn, 2018; Masood, 1979). As the sixth most populous country globally, Pakistan has a youth demographic representing 62% of its population; thus, they are essential for the nation's future development. The use of methamphetamine, especially among individuals aged 14 and older, has emerged as a significant concern with devastating effects. Over the past 2 decades, the prevalence of methamphetamine consumption has dramatically increased, leading to a recognized methamphetamine epidemic in Pakistan (Jan et al., 2021). The repercussions of this epidemic are profound, impacting both the economy and society. Research shows a high level of methamphetamine awareness among Pakistani youth, especially in urban settings. In one study, 42% of adult male respondents reported awareness of methamphetamine, with a significant portion—38.03% of males and 14.08% of

females—having used it recreationally (Ahmed & Hakani, 2018). Six percent of the population in Pakistan have substance use disorders, with the highest prevalence of drug use found in the northern areas of Pakistan (Jan et al., 2022). One study estimated that around 19,000 people in Pakistan have used methamphetamine, and its addiction imposes a financial strain on users and their families, often leading to job loss and financial instability as the cost of maintaining the addiction rises (Iqbal et al., 2020).

The issue of methamphetamine use has escalated to a level where its usage has spread into educational institutions, affecting young people across genders. A qualitative study (Jan et al., 2022) on the primary factors leading to methamphetamine use and its impact on young individuals in South Punjab, Pakistan, identified six main reasons for its initiation: insufficient social and emotional support for youth; the belief that methamphetamine enhances concentration and aids in studying; recreational use and the perception of using methamphetamine as a form of “heroism”; relationship-related stress such as romantic breakups; social pressure associated with

unemployment; and managing stress tied to violating societal or religious norms. Diverse social and psychological challenges contribute to methamphetamine addiction in the region, underscoring the need for comprehensive prevention strategies and support systems for affected youth.

A study conducted in Pakistan found that methamphetamine use was prevalent among young people, with the problem being aggravated by various factors including peer influence, easy access, fun, and work performance enhancement (Sumbal, 2020). Overall, data on methamphetamine use remain scarce, complicating efforts to assess the scope of the issue and provide targeted support. As students in Pakistan are more frequently using methamphetamine, experts caution that this trend of concealed addiction, especially among youth, may grow if preventive strategies and educational efforts are not amplified across communities and educational institutions (Khan, 2021).

Many regional factors may contribute to escalating methamphetamine use in Pakistan. Methamphetamine is readily available at low prices in Pakistan, and law enforcement has increased penalties for methamphetamine distribution. Additionally, secrecy surrounding drug use, particularly in conservative regions, creates significant barriers to treatment, especially for women, who face additional cultural limitations (Aziz, 2021). Many treatment centers are male-centric, and conservative views make it challenging for women to seek help, especially in regions like Khyber Pakhtunkhwa (Ullah, 2021). Families often conceal drug problems to avoid social repercussions. This lack of openness delays intervention and treatment, exacerbating addiction issues in the long run (Nazeer, 2021).

Several factors contribute to methamphetamine use among youth, including the perception of its positive effects (Russell et al., 2008; Sattah et al., 2002). Yen (2006) found that positive attitudes toward methamphetamine are often linked to a lack of awareness of its harmful effects, especially among individuals experiencing psychological distress, such as depression. Curiosity also plays a significant role, as adolescents may seek to experiment and identify with their peers. A lack of coping skills, combined with curiosity, often leads young individuals to engage in high-risk

behaviors (Greydanus & Patel, 2005). Other contributing factors include the drug's availability (Pluddemann et al., 2007), peer influence (McKetin et al., 2005), environmental factors (Visser & Smith, 2007), and the stress of academic pressure, with students resorting to stimulants including methamphetamine to enhance their focus during exams (Chen et al., 2014).

Methamphetamine is a potent central nervous system stimulant that affects the brain and body through multiple mechanisms. Upon administration, methamphetamine triggers the release of dopamine, a pleasure, reward, and motivation neurotransmitter. This rapid increase in dopamine levels reinforces addictive behavior and contributes to the development of psychological dependence. Methamphetamine also increases norepinephrine levels, leading to enhanced alertness, energy, and arousal. Additionally, it modulates serotonin levels, influencing mood, appetite, and sleep. Methamphetamine also affects the balance of inhibitory (GABA) and excitatory (glutamate) neurotransmitters, leading to increased neuronal activity. Chronic methamphetamine use can lead to neurotoxicity, damaging dopamine and serotonin neurons. This damage contributes to cognitive impairment, memory loss, and mood disturbances. Furthermore, methamphetamine activates the hypothalamic–pituitary–adrenal axis, leading to increased stress and anxiety (Cruickshank & Dyer, 2009; Sekine et al., 2008).

The objective of this study was to explore the psychiatric complications faced by adolescents using methamphetamine. Psychiatric complications refer to emotional, psychological, or behavioral disturbances that impair daily functioning, relationships, or overall well-being. Specific complications include anxiety disorders, psychotic disorders, mood disorders, trauma, and stress-related disorders. These symptoms are recorded by indicators including clinical assessments (e.g., using the *Diagnostic and Statistical Manual of Mental Disorders* [DSM-5]) and behavioral observations (e.g., agitation, aggression), with severity levels of mild, moderate, and severe impairment. Assessment tools included the DSM-5. This operational definition provides a clear framework for identifying and assessing psychiatric complications among adolescents using methamphetamine.

Table 1. Demographics of participants.

Demographic information		Frequency	Percentage
Age	19 years	03	70
	21years	02	30
Gender	Male	04	90
	Transgender	01	10
Education	FA	02	40
	Matric.	02	40
	BA	01	20
Profession	Student	05	100
Religion	Islam	05	100
Marital status	Single	05	100
City	Multan	03	70
	Muzaffargarh	02	30

FA = Higher Secondary; BA = mean Graduation.BA mean Graduation" >

Materials and methods

The qualitative case series method employed in this research encompassed research design, data collection, and data analysis practices, allowing for the exploration of theoretical themes (Yin, 2009). Purposive sampling technique was utilized to gather specific and relevant information, serving as a significant tool for in-depth knowledge acquisition regarding individual cases. Five case studies were selected from the Drug Rehabilitation Center in Multan, in Punjab, Pakistan, focusing on participants aged 15 to 25 who used crystal methamphetamine in the past year. Informed consent was obtained and privacy of the patients was ensured. The research was approved by the advisory board of the Government Drug Rehabilitation Center, ensuring compliance with national and international guidelines.

The current instrumental case study employed thematic analysis, as performed by the researcher. Interview data were transcribed verbatim, analyzed, coded around key themes, and interpreted. The analysis was cross-checked for context through both within-case and cross-case examinations. Within-case analysis provided a detailed account of each participant's personal experiences and interpretations, while cross-case analysis contextualized and simplified the findings. The text was scrutinized for homogeneous patterns, leading to the development of subthemes and major themes, with codes assigned to specific phrases. The collective themes were aggregated to form major themes for each interview. Five cases were sufficient to reach thematic saturation, where no new insights or themes emerged from additional data.

Results

As illustrated in Table 1, all participants ($n=5$) reported no family history of substance use. All participants initiated use of methamphetamine (referred to as "ice" by the participants) within educational settings alongside peer groups; smoking tobacco was also prevalent, with an average of 3 to 4 cigarettes consumed daily. Three participants reported inhaling one gram per day, while two others reported using a half a gram on average per day but with variable amounts. Two participants were undergoing their first treatment in an inpatient setting, while three had previously undergone treatment but experienced relapse. Only one participant had a medical history of hepatitis C. During the period of substance use, all participants reported significant disturbances in interpersonal and intrapersonal relationships. Additionally, poor hygiene was reported, and two participants admitted to stealing items from home to fund their methamphetamine use. None of the participants had a criminal history. However, all reported mental health issues, including psychosis (characterized by delusions and hallucinations), self-harm, aggression, insomnia, and suicidal ideation. Notably, no participant had a prior history of psychiatric illness. All five participants met criteria for methamphetamine use disorder, and related diagnoses included substance-induced psychosis, substance-induced mood disorder, substance-induced anxiety disorder, substance-induced sleep disorder, and stimulant withdrawal.

The dominant theme identified was psychosis, met by three participants, which included subthemes of hallucinations, delusions, and paranoia (see Figure 1). Psychosis is commonly reported among methamphetamine users and is recognized as a serious mental health condition. Substance-induced psychosis can have particularly severe consequences. Consistent with findings from Bramness et al. (2012), who reported that 8% to 46% of patients regularly using methamphetamine experience substance-induced psychosis, participants in this study exhibited symptoms akin to those found in primary psychotic spectrum disorders. These symptoms included lack of concentration, persecutory delusions, heightened motor activity, disorganized thoughts, lack of

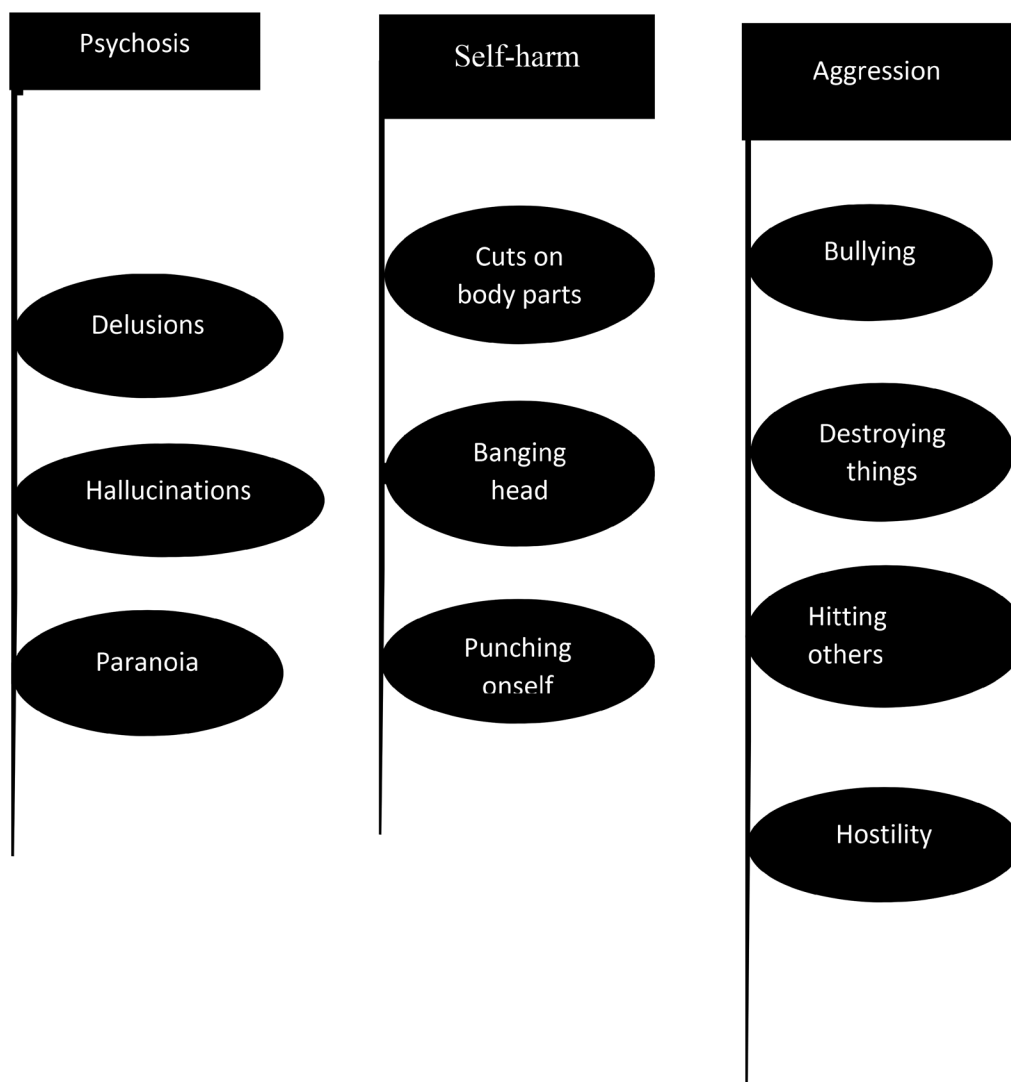


Figure 1. Themes pertaining to mental health problems: psychosis, self-harm, and aggression.
Source: Author.

insight, suspicion, and auditory hallucinations. Participants frequently described feelings of euphoria, increased energy, and racing, disorganized thoughts during episodes of methamphetamine use.

Delusions

Delusions are defined as “fixed beliefs that are not open to change in light of conflicting evidence” (APA, 2013). This phenomenon often results from an inability to distinguish between reality and distorted perceptions. The most prevalent delusion among participants was the belief in being harmed or persecuted, as noted by Arango and Carpenter (2010). For instance, one participant described:

I was seeing that most of the time two persons came into our home from the back door ... I felt overwhelmed with fear. I told my parents, but they didn't trust me. (Interview 1)

Another participant stated:

I saw many strangers living with me at home. ... Whenever I asked for money, they threatened me. (Interview 4)

Hallucinations

Hallucinations may manifest across any of the five senses: auditory, visual, olfactory, tactile, and gustatory. They may occur in isolation or in combination. Most individuals in this case series recognized their hallucinations as unreal, while

attempting to engage in normal behavior. One participant recounted:

My siblings were spying on me. I heard things that my family members couldn't. (Interview 3)

Another added:

I was hearing things that were not audible to anyone else ... I felt like I was a spy providing secret information. (Interview 5)

Paranoia

Paranoia is characterized by unfounded fears and concerns, often involving perceived threats. One participant shared:

I knew there was a person in my home making a conspiracy against me ... I asked my father to approach the police, but he said I was out of my senses. (Interview 2)

Liu et al. (2017) found that individuals with a history of chronic methamphetamine use exhibited schizophrenia-like symptoms, primarily auditory hallucinations and delusions of reference, that persisted for up to 6 months. The descriptions of delusions and hallucinations in this case series were consistent across participants, despite the absence of prior psychiatric illness. After almost 6 weeks, two participants reported continued experiences of hallucinations.

Self-harm

Self-harm emerged as another critical theme, manifesting in behaviors such as cutting, punching oneself, and banging one's head. One participant reported:

I was cutting my arm. ... It gave me pleasure, and I felt calm. (Interview 2)

Another participant stated:

When I take ice, I become irritated and bang my head against the wall. (Interview 3)

Aggression

Aggression was identified as hostile behavior that may result in harm to oneself or others.

Participants reported frequent mood swings, often leading to aggression. One noted:

I become annoyed without reason and start yelling at my family. (Interview 1)

Another added:

I have beaten my brother many times without fear. (Interview 3)

Chronic aggression and self-harm can severely undermine an individual's self-control and may lead to antisocial behaviors, as supported by Lambert (2018), who explored methamphetamine use and its effects on mental health.

Suicidality

Suicidality is a significant concern, especially among adolescents, where it ranks as a leading cause of death. Risk factors include substance use and childhood trauma (World Health Organization [WHO], 2019). In the present study, participants reported suicidal ideation and plans for self-harm, as mentioned in Figure 2. One participant stated:

After 6 months of methamphetamine use, I wanted to kill myself ... I planned to cut my veins. (Interview 5)

Insomnia

Insomnia was another prevalent theme (Figure 2), with participants frequently reporting difficulties in sleeping. Lack of sleep can exacerbate irritability and affect overall mental functioning. One participant shared:

I have been awake for 10 days ... I want to sleep but can't. (Interview 4)

Another stated:

Taking methamphetamine keeps sleep away. ... Even when I close my eyes, my mind remains active. (Interview 2)

While methamphetamine use may initially create feelings of alertness, it ultimately disrupts sleep patterns and can lead to serious mental health issues, including suicidality. Effective interventions and monitoring during withdrawal are critical for enhancing recovery outcomes.

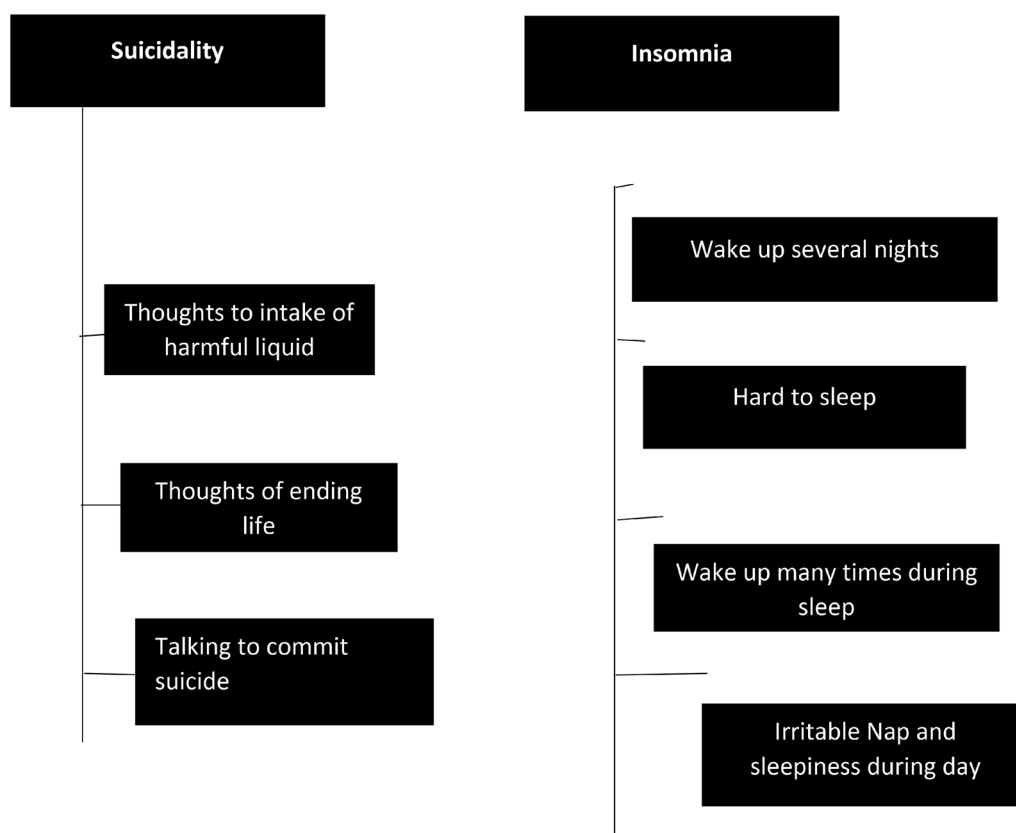


Figure 2. Themes pertaining to mental health problems.
Source: Author.

Discussion

This study concluded that psychiatric complications in adolescents using methamphetamine included methamphetamine-induced psychosis, which in these participants included hallucinations and delusions. This psychosis occurs in part due to the dopaminergic effects of methamphetamine use. These experiences can impair an adolescent's ability to participate in daily life and education and often lead to stigma. Other themes included self-harm, suicidal ideation, and insomnia.

Co-occurring mental health and substance use disorders require integrated treatment. This case series draws attention to the needs of adolescents using methamphetamine with psychiatric complications. Early intervention and treatment are crucial for adolescent methamphetamine use, and respecting the rights of youth and other human rights instruments are key for adolescents' mental health. Trauma-informed care and harm-reduction strategies are essential. Family and peer support

can be important for recovery. Addressing underlying social determinants (e.g., poverty, education) is necessary. Integrated, youth-specific mental health and substance use services are needed. One limitation is that the study included only males, and future directions could include quantitative or qualitative research on psychiatric complications in adolescent females and/or the LGBTQ adolescent population in Pakistan. Other future directions in research could include longitudinal studies that investigate mental health trajectories and treatment outcomes as well as evidence-based development of culturally sensitive interventions for diverse populations.

Conclusion

This study explores psychiatric complications among adolescents using methamphetamine. Promotion, prevention, early detection, and treatment are needed to reintegrate our youth into society and minimize the spread of methamphetamine use (Khan & Fahad, 2019). Potential

treatment options include youth-friendly services to increase access to specialized mental health services; targeted interventions to develop trauma-informed, culturally sensitive programs; family support to educate and support families in coping with a family member's methamphetamine use and psychiatric complications; harm reduction to implement safe consumption spaces and needle exchange programs; policy changes to address social determinants through education, employment, and housing initiatives; and mental health promotion and prevention interventions (Kriticos, 2023; WHO, 2019). These initiatives are aimed at strengthening an individual's capacity to regulate emotions, enhance alternatives to risk-taking behaviors, build resilience for managing difficult situations and adversity, and promote supportive social environments for youth, families, institutions, and society (Amin & Yar, 2024; Islam, 2020).

Acknowledgment

We thank all the participants included in this study and service providers of the Drug Rehabilitation Center Multan Social Welfare & Bait-ul-Maal, Punjab, for their sincere efforts and permission to collect data and to help to conduct indigenous research.

Author contributions

UA has equally contributed to the conception of paper, including draft and review. Conducting interviews and acquisition and discussion for practical implications were her major focuses. She has agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated, resolved, and approved for submission. AA has equally contributed to the conception of paper to final draft. She supervised the whole procedure, provided expert guidance, and approved the final draft for submission. MM has equally contributed to the conception of paper, including draft and review. A major part of his contribution was analysis, and he agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated, resolved, and approved for submission.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Ethical statement

This research upheld and followed ethical standards, including the dignity and privacy of substance users who participated in this study. The research was approved by the advisory board of the Government Drug Rehabilitation Center, ensuring compliance with national and international guidelines.

Funding

The author(s) reported there is no funding associated with the work featured in this article.

ORCID

Uzma Amin  <http://orcid.org/0000-0002-7908-5881>

References

- Abbasi, K. (2016, October 22). Schools shocked by NGO's claims about drug use among students. *Dawn*.
- Ahmed, H., & Hakani, G. (2018). Awareness and use of methamphetamine (ICE) among the people of Karachi, Pakistan. *World Journal of Pharmaceutical Research*, 7(17), 34–43.
- Amin, U., & Yar, M. (2024). Health and well-being of women substance users need safest spaces in Pakistan. *Social Sciences Spectrum*, 3(4), 147–156.
- APA. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*. American Psychiatric Association, American Psychiatric Publications.
- Aziz, N. (2021). Addiction and treatment barriers: Impact of secrecy and cultural limitations on drug treatment access in Pakistan. *Journal of Substance Abuse Treatment*, 11(3), 45–58.
- Bramness, J. G., Gundersen, Ø. H., Guterstam, J., Rognli, E. B., Konstenius, M., Løberg, E.-M., Medhus, S., Tanum, L., & Franck, J. (2012). Amphetamine-induced psychosis—A separate diagnostic entity or primary psychosis triggered in the vulnerable? *BMC Psychiatry*, 12(1), 221. <https://doi.org/10.1186/1471-244X-12-221>
- Chen, L. Y., Strain, E. C., Alexandre, P. K., Alexander, G. C., Mojtabai, R., & Martins, S. S. (2014). Correlates of non-medical use of stimulants and methamphetamine use in a national sample. *Addictive Behaviors*, 39(5), 829–836. <https://doi.org/10.1016/j.addbeh.2014.01.018>
- Cruikshank, C. C., & Dyer, K. R. (2009). A review of the clinical pharmacology of methamphetamine. *Addiction*, 104(7), 1085–1099. <https://doi.org/10.1111/j.1360-0443.2009.02558.x>
- Dawn. (2018, July 06). Around 7 million drug addicts in Pakistan, Senate told. *Dawn*. <https://www.dawn.com/news/1192715>
- Greydanus, D. E., & Patel, D. R. (2005). The adolescent and substance abuse: Current concepts. *Disease-a-Month*, 51(7), 392–431. <https://doi.org/10.1016/j.disamonth.2005.10.002>

- Iqbal, M., Aslam, S., & Hussain, M. (2020). Determinants of Ice (methamphetamine) consumption in South Punjab, Pakistan: A qualitative study. *Pakistan Journal of Criminology*, 12(4), 151–165.
- Islam, M. (2020). State of the art treatment options for Pakistan's opioid, alcohol and methamphetamine crisis. *The Journal of the Pakistan Medical Association*, 70(6), 1063–1068. <https://doi.org/10.5455/JPMA.29284>
- Jan, S. U. K., Ali, A., Niqab, M., & Iqbal, S. (2022). Causes of initiation of methamphetamine use in Khyber Pakhtunkhwa, Pakistan: A qualitative study. *Addicta: The Turkish Journal on Addictions*, 9(3), 264–268. <https://doi.org/10.5152/ADDICTA.2022.22030>
- Jan, S. U. K., Khan, R., Asad, A. Z., & Khan, A. (2021). Socio-economic effects of methamphetamine on the addicts: A study of Khyber Pakhtunkhwa, Pakistan. *Pakistan Journal of Society, Education and Language*, 7(1), 204–214.
- Khan, N., & Fahad, S. (2019). Review of ice drugs utilization in Pakistan. Available at SSRN 3511136.
- Khan, S. (2021, April 21). Crystal meth use surges among students in Pakistan. *DW*. <https://www.dw.com/en/crystal-meth-use-surges-among-students-in-pakistan/a-57257606>
- Klasser, G. D., & Epstein, J. (2005). Methamphetamine and its impact on dental care. *Journal of the Canadian Dental Association*, 71(10), 759–762.
- Kriticos, J. (2023). *Caring for individuals who have used methamphetamine: A study exploring the experiences of West Australian nurses working in an Authorized Mental Health Institute* [Theses].
- Lambert, J. (2018). *A study of methamphetamine abuse and its connection to domestic abuse* [Doctoral dissertation]. Purdue University Global.
- Liu, Y., Hao, B., Shi, Y., Xue, L., Wang, X., Chen, Y., & Zhao, H. (2017). Violent offences of methamphetamine users and dilemmas of forensic psychiatric assessment. *Forensic Sciences Research*, 2(1), 11–17. <https://doi.org/10.1080/20961790.2017.1287155>
- Masood, A. (1979). Opium smoking in the Frontier Province of Pakistan. *Bulletin on Narcotics (United Nations Publication)*, 31(1), 59–60.
- McKetin, R., McLaren, J., Kelly, E., & McKetin, R. (2005). *The Sydney methamphetamine market: Patterns of supply, use, personal harms and social consequences*. National Drug Law Enforcement Research Fund.
- Nazeer, M. (2021). Family secrecy and social stigma: Impact on drug addiction treatment in Pakistan. *Pakistan Journal of Criminology*, 13(2), 113–130.
- Plüddemann, A., Myers, B., & Parry, C. (2008). Fact sheet: Methamphetamine. Alcohol and Drug Abuse Research Unit: Medical Research Council (pp. 1–3).
- Russell, K., Dryden, D. M., Liang, Y., Friesen, C., O'Gorman, K., Durec, T., Wild, T. C., & Klassen, T. P. (2008). Risk factors for methamphetamine use in youth: A systematic review. *BMC Pediatrics*, 8(1), 48. <https://doi.org/10.1186/1471-2431-8-48>
- Sattah, M. V., Supawitkul, S., Dondero, T. J., Kilmarx, P. H., Young, N. L., Mastro, T. D., Chaikummao, S., Manopaiboon, C., & van Griensven, F. (2002). Prevalence of and risk factors for methamphetamine use in Northern Thai youth: Results of an audio computer assisted self-interviewing survey with urine testing. *Addiction*, 97(7), 801–808. <https://doi.org/10.1046/j.1360-0443.2002.00131.x>
- Sekine, Y., Iyo, M., Ouchi, Y., Takei, N., Mori, N., Takahashi, H., Okada, H., Kitagawa, N., Nakashima, R., Matsunaga, T., Fukuhara, K., Iyo, M., Higuchi, S., Kamata, N., & Utsumi, Y. (2008). Methamphetamine-induced neurotoxicity in dopamine and serotonin systems. *Journal of Neuroscience Research*, 86(1), 115–124.
- Sumbal. (2020). Social influences of methamphetamine abuse among youngsters in Mardan. *International Journal of Formal Sciences: Recent and Future Trends*, 6(1), 10.
- Ullah, S. (2021). Gender-specific challenges: Social norms and barriers to addiction treatment for women in Khyber Pakhtunkhwa, Pakistan. *International Journal of Public Health*, 16(2), 67–78.
- United Nations Office on Drugs and Crime. (2013). *Drug use in Pakistan 2013*. Retrieved from https://www.unodc.org/documents/data-and-analysis/statistics/Drugs/Drug%20use/Drug_use_in_Pakistan_2013
- Visser, R. O., & Smith, J. A. (2007). Alcohol consumption and masculine identity among young men. *Psychology & Health*, 22(5), 595–614. <https://doi.org/10.1080/14768320600941772>
- World mental health report: Transforming mental health for all (2022). *World Health Organization*. Retrived from <https://www.who.int/publications/i/item/9789240049338>
- World Health Organization (2020). *Global health estimates 2000–2019*. Retrived from <https://www.who.int/data/global-health-estimates>
- Yin, R. K. (2009). *Case study research: Design and methods*. sage, 5, 12–15.