

Characteristics of Australian adolescent females in residential treatment who report using methamphetamines

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Abstract

Introduction and Aims. To investigate factors associated with methamphetamine use in adolescent females referred to an Australian residential treatment service. **Design and Methods.** A mixed-methods explanatory sequential design was undertaken. Cross-sectional analysis of existing pre-treatment data for adolescent females aged 13–18 years (median 16.48 years) attending a treatment program between 2009 and 2015 ($n = 267$) was undertaken, followed by a focus group and in-depth interviews of key staff. **Results.** Female methamphetamine-users ($n = 127$, 47.6%) were significantly more likely than non-methamphetamine-users at pre-treatment to be in unstable living arrangements, where they moved frequently ($P = 0.025$), lived in more unstable (not rented or privately owned) accommodation ($P = 0.012$) and had problematic family situations ($P = 0.004$). They were more likely than non-methamphetamine-users to be poly-drug users ($P < 0.001$) and to have ever attempted suicide ($P = 0.029$). Cumulative trauma by someone known to the adolescent was the main predictor for female methamphetamine use (odds ratio 3.077). Qualitative data provided context and depth to quantitative findings, with an emphasis on trauma as a precursor to methamphetamine use. The qualitative interviews also highlighted changes made in service provision, given the increasing rates of methamphetamine use. **Discussion and Conclusions.** High levels of trauma and mental health problems in this population support the notion that traumatic childhood experiences are strongly associated with problematic alcohol and other drug use, particularly, methamphetamine use, at a young age. Increased attention to decreasing family violence, abuse and neglect is required and in clinical practice, a trauma-informed model of care is recommended. [Dixon G, Woolfenden S, Jayasinha R, Rawstorne P, Palmer K, Nathan S. Characteristics of Australian adolescent females in residential treatment who report using methamphetamines. *Drug Alcohol Rev* 2017]

Key words: adolescent, female, methamphetamine, trauma, poly-drug use.

Introduction

Methamphetamines have garnered growing attention globally [1]. Heightened public and political concern has seen claims that Australia is experiencing an 'ice epidemic' ('ice' is a term commonly used in Australia for crystal methamphetamine) [2–4]. Australian studies have found a substantial increase in the proportion of younger age groups (15–34 years) using methamphetamines regularly [3,5,6]. Smoking has become the most common route of administration in younger age

groups suggesting the purer, more crystalline form is increasingly used [3,5,6]. Concurrent rising rates of methamphetamine-related ambulance use, hospitalisations, overdoses resulting in death, and treatment-seeking has been observed [2,6,7].

In Australia, adolescents seeking treatment for problematic alcohol and other drug (AOD) use are most likely to access counselling, information and education, and support and case management [8]. Though only a small percentage (3.3%) of adolescents access residential treatment [8], they are a group likely to

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have complex care needs [9–14]. Adolescents in residential care have been shown to be a vulnerable population [6]. There has been a large increase in methamphetamine use amongst these adolescents [6].

Vulnerable groups of adolescents found to be more likely to use methamphetamines internationally include: adolescent females and older adolescents [15], adolescents who experienced higher levels of aggressive/delinquent behaviour, and those who experienced repeated childhood sexual abuse (before 16 years) [16]. There is a global paucity of recent research examining predictors of adolescent methamphetamine use, especially amongst females and those accessing treatment [1,15]. This is particularly the case in Australia, which has higher rates of methamphetamine use than other countries [17]. Limitations of the existing knowledge base on adolescent methamphetamine use include that the prevalence, type of methamphetamine and route of administration have altered substantially over the last 10 years [3,5,6]. Additionally, mixed populations of adults and adolescents, single sex populations, or non-treatment populations are commonly used [9,11–13,18–20]. It is important to examine female methamphetamine-users separately from males because there is evidence of young adolescent females entering treatment for methamphetamine use at higher rates than males [21], yet they are under-represented in treatment globally and in Australia [1,8] and are an understudied group [1,15]. Furthermore, adult female methamphetamines-users are more likely to report previous trauma than male users [22]. It is important to investigate if this trend, and other trends seen in adult populations [22,23], translate to the adolescent population.

The purpose of this study is to investigate the risk factors associated with methamphetamine use in adolescent females referred to an Australian residential treatment program. This is vital evidence to inform therapeutic models to treat female adolescents with problematic AOD use, particularly methamphetamine-users.

Methodology

Study design

This mixed-methods explanatory sequential design study had two components; the initial quantitative phase, which informed the second, qualitative phase [24]. The first phase involved cross-sectional analysis of existing pre-treatment quantitative data for adolescent females aged 13–18 years attending a residential treatment program in Australia ($n = 267$) to examine risk factors for methamphetamine use, previously identified in literature, such as sociodemographics, including housing stability, and life experiences such as trauma.

The subsequent qualitative phase used in-depth key informant interviews and a focus group with treatment staff to explore potential explanations and elaborate meanings for the quantitative results [24]. Staff perceptions of risk factors for methamphetamine use based on clinical experience were explored. Quantitative results were then shared and discussion focused on understanding these findings in their clinical context. The study was approved by the Human Research Ethics Committees of the University of New South and the Aboriginal Health and Medical Research Council of New South Wales (NSW).

Setting

The residential treatment program (Program for Adolescent Life Management) PALM is a modified Therapeutic Community [25] based in NSW and the Australian Capital Territory (ACT) for adolescents aged 13–18 years experiencing difficulties relating to problematic AOD use. Adolescents come from urban and regional areas across Australia, mostly from NSW and the ACT. The treatment program is the only not-for-profit non-government organisation in NSW or ACT which accepts ‘community referrals’ of adolescents aged under 16 years. Eligibility is based on the ‘Pre-Treatment Assessment’, and those demonstrating significant problematic AOD use, usually always meeting the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition (DSM IV) criteria for substance abuse or dependence are admitted to the program. DSM IV criteria are used to ensure consistency and continuity in the eligibility criteria and data integrity. Furthermore, while the DSM V provides clear criteria for ‘substance-use disorder’ and severity indicators [26], it does not have the same distinction as the DSM IV between ‘substance abuse’ and ‘substance dependence’ [27], which has been argued to not capture broader social dimensions of problematic drug use, particularly in adolescent populations [28,29]. Significant risk-taking behaviour, adverse implications, and impairment of the adolescent’s life and function within their family and wider society also require consideration [28,29], as is seen in this service, where the DSM criteria is used to guide holistic clinical decisions.

Recruitment

Cross-sectional component. Pre-treatment data included in the study were from all adolescent females admitted to the program from 2009 to 2015. All adolescent females presenting for their first admission within that timeframe ($n = 267$) were included in analysis. Analysis did not include adolescent females who were referred to the program but did not attend. In 2015,

72% of all adolescents (males and adolescent females) who undertook the 'Pre-Treatment Assessment' were admitted. Main reasons for non-admission were loss of interest or being refused bail.

Qualitative component. All full-time treatment staff ($n = 15$) at the NSW site in the second half of 2016 were invited to participate in a focus group. Sampling was opportunistic or convenience sampling. The invitation was via email from the head office administrative manager and followed up on the day of the focus group by the site-manager. Those willing to participate came to the designated room, where informed written consent was obtained. The focus group explored underlying factors leading to treatment, particularly focusing on adolescent females. Key informant interviews were subsequently conducted with a purposefully sampled subset of employees from NSW and ACT facilities. These key informants were selected as they had a long history of working with the client group and held senior leadership roles in the program.

Data collection and measures

Cross-sectional component. The Pre-Treatment Assessment, a 120-item assessment, collects baseline data at the time of referral. It relies on self-reporting and is conducted via phone or in-person by program counselors. Currently, an average of 75% (across sites) of Pre-Treatment Assessments are conducted via phone.

Salient variables were selected from the Pre-Treatment Assessment for analysis based on a literature review, highlighting gender, age, traumatic experiences—including sexual abuse, and co-morbid mental health problems as possible factors in methamphetamine use [15,16,21]. AOD use patterns, mental health and trauma history were key variables. Where necessary, variables with multiple categories were collapsed into fewer categories to avoid cells with small n sizes, and to increase power for statistical analyses.

Sociodemographic variables. Age, initially collected based on date of birth as a continuous variable, was dichotomised into '16-years and over' and 'under 16-years'. Aboriginality was categorised as 'Aboriginal and/or Torres Strait Islander' and 'not'. Education level was dichotomised 'before year 10' and 'year 10 or above'. Suspension or expulsion, and inclusion in a special class (for behavioural/learning difficulties) were collected as dichotomous data. Criminal involvement was measured through number of arrests in the last 3 months, dichotomised into 'no arrests' and 'one or more arrests'. Stability of residence was measured based on the number of places lived in the last 6 months, dichotomised into 'living in one-two places'

and 'living in three or more places'. Usual living arrangements were dichotomised into rented and private house/flat types (considered 'stable') and all remaining accommodation types (considered 'unstable': e.g. caravan, prison, homeless).

Psychosocial variables. Three validated scales were used to measure psychosocial function. The General Functioning Scale, a sub-set of the Family Assessment Device, comprises 12-items that measure the overall functioning and health of a family from the perspective of the family member assessed [30,31]. Each item is scored 1–4 and then averaged. A total score of 2.00 or above indicates problematic family functioning. The higher the score, the more problematic the family member perceives the family's functioning [30]. The continuous score was dichotomised as score < 2 ('no problematic family functioning') and score ≥ 2 ('problematic family functioning'). Missing values were incorporated via linear interpolation.

The Psychological Functioning Scale (PFS), from the Brief Treatment Outcome Measure: Opioid Maintenance Pharmacotherapy [32], involves eight questions about psychological functioning. For example: 'In the last 3 months have you had significant problems with feeling very trapped, lonely, sad, blue, depressed or hopeless about the future?' The PFS is scored by adding the total number of 'yes' responses (each worth one point), with higher scores indicating higher levels of psychological problems.

The Social Functioning Scale (SFS), from the Brief Treatment Outcome Measure: Opioid Maintenance Pharmacotherapy [32], has six items measuring financial hardship, social/family conflict, peer relationships, time spent in social interactions (with drug users and non-drug users), and recent involvement in criminal activity and child protection. The SFS is scored following specific requirements, where responses are added together. The sum total is multiplied by a particular coefficient depending on the number of 'not applicable' answers given [32]. A higher score correlates with higher levels of perceived social dysfunction [33,34].

Drug use patterns. 'Current' drug use was based on AOD adolescents reported using at the time of the Pre-Treatment Assessment. Adolescents were first asked the age when they started using a range of substances and then if they were 'still using' this drug. This measure was the best indicator of current use. Responses were dichotomous ('yes'/'no'). Due to the small proportion of adolescents who endorsed using some of the drugs an 'other' category was created, incorporating: tranquilisers, inhalants, prescription medications, over-the-counter medications and steroids. Current poly-drug use was calculated as a continuous variable, based on the number of drugs each person separately endorsed, excluding methamphetamine.

The dependant variable, methamphetamine, includes crystal, powder and paste methamphetamines, but not ecstasy. It has been demonstrated that in this population the most common methamphetamine being used is crystal methamphetamine [6].

Mental health and trauma. Indicators of mental health problems that were investigated were: suicide attempts and self-harm, both asked as ‘ever’ and ‘recent’ (last 3 months) and measured as dichotomous (‘yes’/‘no’) categorical variables, with no further recoding required.

Data on traumatic experiences was collected using dichotomous (‘yes’/‘no’) categorical variables, with no further recoding required. Adolescents were asked if they had witnessed or experienced different traumatic events; the following were included in the study: physical assault by someone known to the adolescent, physical assault by a stranger, verbal/emotional abuse, sexual assault by someone known to the adolescent, and sexual assault by a stranger. A cumulative measure of traumatic experiences was developed as an ordinal categorical variable. It is a composite of trauma-related variables: physical assault by someone known to the adolescent, verbal/emotional abuse, and sexual assault by someone known to the adolescent.

Qualitative component. Qualitative data collection was undertaken in the second half of 2016 by the lead author. The discussion guide was developed by the project team to be appropriate for both the interviews

and the focus group. It was adapted to suit the discussion, experiences and areas of expertise of the participants, as is common in semi-structured interviews [35] (Figure 1). The focus group and individual interviews were conducted face-to-face at the treatment facility or via teleconference. After discussing the initial questions (Figure 1), the participant(s) were shown the data, which outlined the characteristics of the clients, and highlighted differences between the adolescent males and females, and addressed methamphetamine use in adolescent females. The data was used to prompt discussion about the findings, including methamphetamine use. Focus group and interviews were recorded and transcribed verbatim. Data were de-identified and stored on a secure password-protected server with restricted access.

Data analysis

Cross-sectional component. Descriptive statistics from Pre-Treatment Assessment responses were analysed using IBM SPSS Statistics Version 23.0 [36]. Key variables selected based on reviewing the literature were examined and female methamphetamine-users and non-methamphetamine-users were compared using χ^2 -square tests for independence for categorical variables and independent samples *t*-tests for continuous variables.

Significant variables ($P < 0.05$) at a bivariate level were used in the starting model of a multivariable

Staff opinions

(Not yet shown quantitative findings)

1. Can you explain from your perspective the key factors that bring young people to treatment?
2. Are these factors different for adolescent females compared to males?
 - a. How?
3. Key aspects of program that you think address these issues?

-----DATA PRESENTATION-----

Reflecting on data

4. Thoughts on data vs. experience?
 - a. Why do you think the patterns are what they are?
 - b. How is PALM addressing the increasing meth usage
–probe: longer detox, more damage, etc.
5. Implications on management → does this align with what was said previously?
 - a. Do you think current approaches are meeting these needs?

Figure 1. Interview/focus group discussion guide.

Table 1. Univariable associations between sociodemographic factors, drug use patterns, mental health and trauma witnessed or experienced by methamphetamine use

Sociodemographic factors				
Characteristic	N	Meth-users, N = 127 (47.6%)	Non-meth-users, N = 140 (52.4%)	P
		(n %)	(n %)	
Age over 16 years	267	84 (66.1)	88 (62.9)	0.576
Identify as aboriginal and/or Torres Strait Islander	267	31 (24.4)	45 (32.1)	0.162
Completed/completing year 10 or above	267	31 (24.4)	44 (31.4)	0.203
Ever suspended/expelled	261	102 (81.6)	108 (79.4)	0.656
Ever in a special class at school	261	49 (39.2)	42 (30.9)	0.159
Arrested in last 3 months	241	46 (40.4)	41 (32.3)	0.193
Current court involvement	265	57 (45.2)	58 (41.7)	0.565
Three or more places of residence in last 6 months	261	65 (52.0)	52 (38.2)	0.025
Unstable accommodation	267	35 (27.6)	21 (15.0)	0.012
Current drug use patterns				
Drug type	N	Meth-users, n (%)	Non-meth-users, n (%)	P
Cannabis	267	112 (88.2)	115 (82.1)	0.167
Alcohol	267	89 (70.1)	95 (67.9)	0.695
Tobacco	267	119 (93.7)	109 (77.9)	<0.001
Opioids	267	16 (12.6)	6 (4.3)	0.014
Ecstasy and related drugs	267	56 (44.1)	32 (22.9)	<0.001
Cocaine	267	18 (14.2)	10 (7.1)	0.061
Hallucinogens	267	23 (18.1)	6 (4.3)	<0.001
Other	267	24 (18.9)	20 (14.3)	0.310
Mental health				
Mental health measure	N	Meth-users, n (%)	Non-meth-users, n (%)	P
Attempted to end life—ever	267	83 (65.4)	73 (52.1)	0.029
Attempted to end life—last 3 months	267	36 (28.3)	43 (30.7)	0.672
Self-harmed—ever	266	89 (70.1)	85 (61.2)	0.126
Self-harmed—last 3 months	267	32 (25.2)	31 (22.1)	0.557
Trauma				
Trauma—experienced or witnessed	N	Meth-users, n (%)	Non-meth-users, n (%)	P
Physical assault by someone known	267	98 (77.2)	88 (62.9)	0.011
Physical assault by stranger	267	53 (41.7)	44 (31.4)	0.080
Sexual assault by someone known	267	58 (45.7)	41 (29.3)	0.006
Sexual assault by stranger	267	26 (20.5)	24 (17.1)	0.486
Verbal abuse	267	82 (64.6)	67 (47.9)	0.006

binary logistic regression analysis to establish which factors were independently associated with the dependent variable (methamphetamine use). Variables with a significance level >0.05 were manually removed from the model at each iteration until the final model contained only variables with a significance level < 0.05.

Qualitative component. Inductive thematic analysis of the verbatim interview and focus group transcripts was conducted by the lead author [37]. Qualitative data was used to contextualise quantitative findings, providing explanations and clinical insight [24].

Results

Quantitative results

See Table 1 for sample characteristics discussed below.

Description of sample. There were 267 adolescent females admitted to the program during the period 2009–2015 and all had data available for analysis. The methamphetamine-users comprised 47.6% of the sample. Mean age of the study sample was 16.48 years (range 13.4–18.1 years). Methamphetamine-users were significantly more likely to have lived in three or more places in the last 6 months (52% of methamphetamine-users *vs.* 38.2% non-methamphetamine-users) and to have been recently living in unstable accommodation (27.6% methamphetamine-users *vs.* 15% non-methamphetamine-users).

Methamphetamine-users were more likely to be experiencing problematic family functioning, scoring significantly higher on the Family Assessment Device scale ($M = 2.62$; $SD = 0.47$) than non-methamphetamine-users ($M = 2.45$; $SD = 0.51$), $t(265) = 2.878$, $P = 0.004$. Both methamphetamine-users and non-methamphetamine-users had high scores, with no significant difference between the groups, on the SFS. Methamphetamine-users had a mean score of 13.07 ($SD = 3.69$), while non-methamphetamine-users had a mean score of 12.37 ($SD = 3.79$), $t(264) = 1.53$, $P = 0.127$. There was no significant difference on the PFS. Methamphetamine-users had a mean score of 6.21 ($SD = 2.20$) and non-methamphetamine-users had a mean score of 6.07 ($SD = 2.20$), $t(265) = 0.52$, $P = 0.602$.

Drug use patterns. Methamphetamine-users were significantly more likely to report using several drug classes than non-methamphetamine-users for current drug use. Specifically, they were significantly more likely to report using tobacco (93.7% methamphetamine-users *vs.* 77.9% non-methamphetamine-users), opioids (12.6% methamphetamine-users *vs.* 4.3% non-methamphetamine-users), ecstasy (44.1% methamphetamine-users *vs.* 22.9% non-methamphetamine-users) and related drugs, and hallucinogens (18.1% methamphetamine-users *vs.* 4.3% non-methamphetamine-users). Methamphetamine-users were significantly more likely to be poly-drug users (i.e. use other drugs in addition to methamphetamine); methamphetamine-users averaged 3.59 drugs ($SD = 1.39$) compared to non-methamphetamine-users, with a mean of 2.81 ($SD = 1.41$), $t(265) = 4.60$, $P < 0.001$.

Mental health and trauma. A high burden of mental health problems and traumatic experiences were

Table 2. Final multivariable logistic regression model of methamphetamine use

Number of traumas witnessed or experienced	OR	95% CI	<i>P</i>
<i>Trauma</i>			
0 types of trauma (reference category)	1	—	0.002
1 type of trauma	1.053	0.481–2.303	0.898
2 types of trauma	2.450	1.213–4.950	0.013
3 types of trauma	3.077	1.452–6.520	0.003

CI, confidence interval; OR, odds ratio.

reported across the sample. Methamphetamine-users were significantly more likely to report having ever attempted suicide and were significantly more likely to have experienced or witnessed a traumatic event perpetrated by someone known to them. Specifically, methamphetamine-users were more likely to have witnessed or experienced physical assault by someone known to them, sexual assault by someone known to them, and verbal abuse.

Multivariable predictive model of methamphetamine use.

All variables with a significance of <0.05 at a bivariable level were included in the analysis and the model was manually adjusted such that variables that lost significance (>0.05) were removed.

The composite variable, ‘cumulative trauma’ held sole significance, cancelling out all other variables in the final multivariable binary logistic regression model. Indicator contrasts showed a significant difference for two and three types of trauma compared with the reference category of no trauma types, denoting a cumulative effect of trauma associated with a greater likelihood of engaging in methamphetamine use (Table 2). The final multivariable binary logistic regression model correctly predicted methamphetamine use, or not, in 61% of cases.

Qualitative results

Focus group participants ($n = 4$) included AOD workers and counsellors and three key informants (managers of the programs) were interviewed. Focus group participants self-selected as senior staff members present on the day of the focus group, leaving more junior staff to manage the program in their absence. They represented a wide range of experiences in managing the ‘cold-face’ of the program, supporting the adolescents on a day-to-day basis, including in a counselling role. The qualitative data provided support for, and some possible explanations for the quantitative findings. These explanations were based on clinical experience working with adolescents.

Additional themes were also raised by staff that were not reflected in the quantitative data. The most common theme relating to female methamphetamine use was trauma. Trauma was focussed on particularly in the interviews with more experienced staff, as they are in positions that deal more directly with trauma counselling than the AOD workers.

Trauma history and experience. All staff suggested methamphetamine use was linked to past experiences of trauma, commonly complex trauma. This was the major focus of discussion prior to viewing the quantitative data. The service differentiates ‘simple’ and ‘complex’ trauma. Simple trauma is defined as a one-off event that promotes a negative physical, cognitive and emotional response. Complex trauma is defined the combination of multiple or recurrent simple traumas, and the long-term impacts and (snowballing) effects that has on the adolescent. It considers the changes the ongoing trauma has on their overall development and life function [e.g. schooling: (non-)attendance and bullying].

On seeing the data, all staff emphasised that actual rates of trauma would be far higher than seen in the data. Staff felt that some adolescents may not feel comfortable disclosing such information in the Pre-Treatment Assessment, as it is their first point of contact with the program. Staff described the impact of complex trauma on adolescents and why these experiences often led to drug use, particularly methamphetamine (ice), mentioning that adolescents reported feeling euphoric and good about themselves when taking ice, which is something that they are not often able to feel frequently in their lives.

‘At their core, people who have been through really complex trauma have a really poor sense of self-identity ... they’re kinda hypervigilant in needing to find a meal when you’re five or six years old, or picking the sound of a certain car pulling into the driveway, picking the scent of alcohol on someone’s breath when they get home. All that sort of stuff means that they never really get a chance to sort of focus inwards. And so, something like ice just gives that instantly.’ (Interview 2)

Staff perceived mental health problems and higher levels of suicide attempts in adolescent females using methamphetamine could be related to their AOD use as well as a precursor to AOD (especially methamphetamine) use, due to a history of trauma. Staff perceived methamphetamine use, particularly crystal methamphetamine, could lead to suicidal ideation, but it was also likely that the adolescent females using

methamphetamine probably had a higher propensity to attempt suicide or to self-harm due to previous traumatic experiences and a desire to ‘escape’ their thoughts and situations prior to methamphetamine use.

An alternative explanation proposed for the high rates of trauma was an association with AOD-use and the adolescent females finding themselves in higher-risk situations. Staff also noted that often the female clients find themselves in relationships with older men who are drug dealers, putting them at further risk:

‘They’ve had that initial trauma, and then they’ve got the low self-worth and then they get with someone that treats methamphetamine them like that [relating to prior discussion of domestic violence] because they don’t think they deserve any better.’ (Interview 1)

Qualitative findings in relation to methamphetamine use and trauma highlight the complexity of the relationship, with staff generally agreeing that prior trauma is a major factor in adolescent female methamphetamine use. Some also argued that using methamphetamine and relationships that are associated with methamphetamine use put adolescent females in situations where they are at risk of violence and further trauma.

All staff commented on significant changes to the day-to-day management of the program considering the changing AOD-use patterns being seen in clients, acknowledging that adolescents with a history of methamphetamine use ‘*tick a little bit differently*’ (interview 2) and ‘*are a lot more volatile*’ (interview 3). Rather than expecting full program participation from the outset, adolescents who were known methamphetamine-users were given more time and space to detox within the program, giving them an opportunity to rest before being expected to have full program involvement.

‘Before, it used to be: “come in and, bang! Get straight into it” sort of thing. But we know that with heavy methamphetamine-users that they just need to crash for a bit. ... There’s an element of physical and mental exhaustion...’ (Interview 2)

In the focus group, the respondents also highlighted that there was a more holistic approach in the program, aimed at harm minimisation. Specifically, they emphasise basic life skills and management, in addition to addressing the adolescents’ drug intake.

Interviews with senior staff also highlighted the inclusion of more specific training and education for the staff. Training in trauma-based care, conflict resolution and motivational interviewing were highlighted. Senior staff all raised that more patience and clarity was necessary when working with clients with a

significant methamphetamine history, highlighting that *'it generally takes a lot longer to build therapeutic relationships'* (interview 3).

Discussion

In this study, experiences of trauma were found to be predictive of methamphetamine use in adolescent females, with a cumulative effect demonstrated in both quantitative and qualitative analysis. That is, experiencing or witnessing more types of trauma was associated with increasing likelihood of methamphetamine use. As the quantitative findings are cross-sectional, causality cannot be determined by quantitative analysis alone, the qualitative data, however, provides some support for the hypothesis that trauma is likely, in many cases in this population, to precede methamphetamine use. This was a theme that was prevalent in the qualitative component, with staff discussing their perception of a strong link between a history of complex trauma and methamphetamine use. Staff also commented, however, that traumatic experiences may be an outcome of methamphetamine use and that adolescent females who use methamphetamines might find themselves consequentially higher-risk situations or with mental health problems. The association between experiencing traumatic events in childhood and the development of problematic AOD use and other psychopathology in adulthood is well documented [9,11–14]. This risk is often found to be subject to a cumulative effect, with a greater number of traumatic experiences associated with increased risk of adverse outcomes [38,39]. The cumulative effect of trauma however, has not been previously studied in relation to adolescent AOD use.

The high rates of complex trauma seen in this population provide strong support for trauma-based care as a key treatment focus. The staff discussed changes in practice implemented in response to growing methamphetamine use in their clients, such as allowing detox time within the program and increased education, training and upskilling of program staff. There is growing evidence demonstrating that trauma-informed models of care can meet the multifaceted needs of vulnerable adolescents and help build resilience and positive coping strategies [40–42]. Further, given the strong perception among the staff that methamphetamines can help adolescents to cope and reduce hypervigilance, strategies to promote self-reflection without the use of AOD is likely to be an important part of models of care designed to build resilience. Such approaches should be included in AOD treatment programs for adolescents, particularly in residential treatment populations, where reported trauma rates are high. Further research on the efficacy and long-term

outcomes from a trauma-based model of care for adolescents with problematic AOD use and associated life problems should be a priority. More broadly, the significant role of trauma in problematic AOD use necessitates improved attention to decreasing family violence, abuse and neglect.

Compared to an Australian population survey of 12–17 year olds, rates of suicide and self-harm in this study population are far higher [43]. Of methamphetamine-users, 65.4% reported ever attempting suicide, compared to 52.1% of non-methamphetamine-users, and 4.5% of the 'normal' population [43]. Higher rates of mental health problems were linked by staff to both a history of trauma and AOD (particularly methamphetamine) use, with staff reporting that trauma commonly precedes AOD use, although AOD use can also put clients at further risk of trauma. Findings from this adolescent population align with studies of adult, where methamphetamine-using females were significantly more likely to experience psychological distress, including depressive mood disorders, than male methamphetamine-users [23]. The current study found methamphetamine-users significantly more likely to be living in unstable accommodation, be experiencing family problems, and to be poly-drug users compared to non-methamphetamine-users. Studies have linked family dysfunction and youth homelessness with increased rates of adolescent AOD use [44].

This sample is from only one program, though it operates across two sites and receives referrals from across two major jurisdictions in Australia (NSW/ACT). The program is also the only one in these jurisdictions designed specifically for adolescents accepting 'community referrals' for those as young as 13-years of age with over 200 admissions each year. The study sample therefore represents a unique and important population group. Service delivery does vary between providers and so studies across different treatment facilities would be valuable to assess the generalisability of these findings to other adolescents with substance-use issues and complex care needs. The qualitative sample was small ($n = 7$), however, key program staff had a long history at the service and working with the client group were sampled.

Limited disclosure is a restraint of this study, supported by staff feedback, underscoring the need for improved data collection practices in treatment services, an important consideration for service providers. Recently, there has been a shift in practice at this service to update the database if the adolescent discloses higher levels of trauma than originally reported, as they progress through treatment. The quantitative data in this study was collected at the time of first-contact with the service and adolescents may not have fully

understood the questions, or might have been reluctant to respond due to concerns about confidentiality and lack of trust. High levels of under-reporting are also expected based on other population studies with similar measures [43,45,46]. The service is introducing a standardised trauma inventory to be used by the counselors if an adolescent shares a history of trauma, at which stage there is both more time and more trust/rapport, mitigating many of the issues with the current trauma measure in the Pre-Treatment Assessment. This was not in place at the time of the study. The study was strengthened however by including a qualitative component seeking the views of key informants to corroborate the quantitative findings. Difficulty with collecting this data highlights an area for future research.

The data used comes from administrative surveys for clinical management, which has resulted in missing data for some variables. Additionally, the data is self-reported in a lengthy survey, generally conducted over the phone. Some of the scales used in the Pre-Treatment Assessment included in the analysis have only been validated in adult populations (Family Assessment Device, PFS and SFS) [30,32,33], highlighting the need for the development and psychometric testing of measures specifically for adolescents.

Conclusion

This study provides critical insights into the characteristics of adolescent females who present for residential treatment for problematic AOD use in Australia. Female methamphetamine-users were significantly more likely to be in unstable accommodation, have problematic family situations, be poly-drug users and to report having ever attempted suicide than non-methamphetamine-users. High levels of trauma and mental health problems were found in both methamphetamine-users and non-methamphetamine-users, but were significantly higher on some measures in methamphetamine-users. Cumulative trauma by someone known to the adolescent was significant in predicting methamphetamine use in this population. Qualitative discussions with staff added context and depth to the interpretation of the quantitative findings and provided a clinical understanding, strongly emphasising the role of trauma as a precursor to methamphetamine use, but also highlighted the potential for trauma to be an outcome from methamphetamine use.

Given the significant role of trauma in this population, the findings have important implications for treatment approaches. Findings suggest improved attention to decreasing exposure to trauma is required, with proactive government policy to prevent exposure to violence in children and adolescents. The high rates of complex trauma seen in this population provide strong support for

trauma-based care as a key treatment focus. Evidence based trauma-informed models of care can meet the multifaceted needs of vulnerable adolescents and help them to build resilience and positive coping strategies.

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Conflict of interest

KP is an employee of the Ted Noffs Foundation, which operates the treatment programs which are the focus of this study. Ted Noffs Foundation staff have not been directly involved in the analysis of the data. KP as an author has contributed to the write up of the findings by providing clinical insights. The Ted Noffs Foundation are also a signatory to an Australian Research Council Funding Grant (LP140100429) and associated contract, which the study reported in this paper informs. In this contract, Ted Noffs have stated their commitment to acting on the findings of the research undertaken at the University of New South Wales, both positive and negative, about their programs. No other authors have a conflict of interest to declare.

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