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Factors associated with continued solvent use in Indigenous petrol sniffers following treatment

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Abstract

Introduction and Aims. While petrol sniffing afflicts several isolated Indigenous groups internationally, few studies have examined the factors contributing to continued sniffing following treatment. This study aims to describe those factors in a group of Aboriginal Australian users. **Design and Methods.** During residential treatment, 56 petrol sniffers completed baseline demographic and substance use questionnaires and cognitive and psychological assessments. Eighty per cent were reassessed and interviewed an average of 9 months ($SD = 4$) later. Cognitive, psychological, substance use and sociocultural factors were compared between those who relapsed at follow up and those who maintained abstinence. **Results.** More males ($n = 44$) than females ($n = 12$) were studied. Of the 45 individuals followed up, 58% ($n = 26$) relapsed. Significant risk factors for relapse included the ready availability of petrol, living in urban centres, being unmarried and living with fewer people ($P < 0.05$). Other potential risk factors, indicated by P -values < 0.10 , included younger age of first petrol use, having sniffed within 14 days prior to treatment, poly substance use, sniffing in response to negative emotions, and feeling lonely at baseline and having sleep problems at follow up. **Discussion and Conclusion.** This study identified psychosocial factors that may be associated with continued petrol sniffing among Aboriginal Australians post treatment. Future research, interventions and policy relating to petrol sniffing should consider these factors. [Dingwall KM, Maruff P, Clough AR, Cairney S. Factors associated with continued solvent use in Indigenous petrol sniffers following treatment. *Drug Alcohol Rev* 2012;31:40–46]

Key words: petrol sniffing, Indigenous, solvent, relapse.

Introduction

Petrol inhalation or 'petrol sniffing' is a form of volatile solvent abuse that occurs almost exclusively in marginalised, isolated or Indigenous groups, such as the American Indians, Aboriginal Canadians and Aboriginal Australians [1]. Many of the Indigenous groups affected share unique cultural, geographical and social characteristics, including histories of cultural oppression and dispossession, geographical isolation, and significant economic, social and cultural disadvantage [1,2]. Petrol sniffing occurs in these contexts primarily among individuals aged between 7–30 years with peer pressure, boredom or curiosity, accessibility, familial disruption, escape from despair or worry, rebellion, and high acculturative stress commonly espoused as con-

tributing factors [1,3–6]. Occasional or experimental use patterns appear most common; however, where chronic or long-term use occurs this can be associated with significant cognitive and neurological impairments [4,7–9]. Importantly, increasing exposure to petrol is associated with a greater degree of brain dysfunction and reduced chances that brain function will fully recover with abstinence [10,11].

Treatment for petrol sniffing can be complex, with traditional treatment programs unlikely to be effective in solvent users who are described as among the most difficult and refractory drug users to treat [12,13]. Solvent users are often involuntary clients, admitted by family or community workers, and usually present with a wide variety of issues impacting cognitive, mental, physiological, social, educational and economic

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domains [12,13]. While some treatment programs have been developed specifically for solvent abuse, knowledge about post-treatment outcomes of these programs is limited [12,14] and few studies have examined factors that may contribute to continued solvent use following treatment [15]. Hence, the aim of this prospective but exploratory study was to identify baseline and post-treatment factors that are related to continued petrol sniffing in an Aboriginal Australian group following discharge from treatment. Substance use, sociocultural, cognitive and psychological factors were assessed for petrol sniffers upon entering treatment and again approximately 9 months later.

Methods

Participants

Participants were 44 males and 12 females (mean age = 18 years; SD = 5.16) attending rehabilitation for petrol sniffing in the Northern Territory between 2007 and 2009. The majority (86%; $n = 48$) came to rehabilitation from remote communities. The average age of first petrol use was 13 years (SD = 3.07) with an average of 5 years' use (SD = 4.83). Five participants had inhaled substances other than petrol (i.e. paint, glue or aerosols). Frequency of use ranged from once per week to everyday with the majority (54%; $n = 30$) sniffing 4–7 days per week.

Procedure

The joint Human Research Ethics Committee (including the Aboriginal Ethics Sub Committee) for the Department of Health and Community Services and Menzies School of Health Research granted ethical approval for the study. Researchers visited two urban-based residential rehabilitation centres fortnightly during 2007–2009. During 2008, they also visited opportunistically (nine times), a remote outstation for petrol sniffers approximately 300 km from an urban centre. The urban-based rehabilitation programs incorporated three main components: drug education and goal planning sessions, life skills (e.g. health, hygiene, budgeting, nutrition) sessions and recreational sessions, including cultural activities. The outstation program involved education, as well as personal and skills development, including participation in practical pastoral activities. All treatment programs prohibited substance use apart from tobacco while in treatment. All individuals attending treatment for petrol sniffing, who were present on the study days were invited to participate. Individuals (and their legal guardian if under 18 years of age) were informed that participation was voluntary and gave written informed consent prior to participation.

At baseline, an average of 11 days (SD = 9.4) from admission to treatment, participants completed demographic and substance use questionnaires, and psychological and cognitive assessments.

An average of 9 months (SD = 4) after treatment, 21 participants were reassessed in their home communities with the cognitive and psychological assessments, and were interviewed about the context of their petrol and other drug use. Researchers also examined clinic notes and interviewed up to three key informants (usually a community health worker, or friend or family member), either face-to-face or via the telephone, regarding all participants' continued use of any substance (42 participants gave consent to this process at baseline). This information was used to categorise unreachable participants ($n = 24$) as abstainers or relapsed users and also to verify self-report substance use data. The use of proxy assessments in this population has been described elsewhere, and good agreement with self-reported substance use is generally observed [16,17].

Demographic questionnaire

Participants completed this questionnaire at baseline that included information about age, gender, medical history, languages spoken, English proficiency, community and employment status.

Substance use history questionnaire

This questionnaire was completed at baseline and investigated current or previous use, frequency of use, age of first use, days since last use and amount usually consumed for each substance (i.e. petrol and other solvents, alcohol, tobacco, cannabis and 'other').

Psychological screening tool

This measure consisted of eight items based on the Strong Souls Inventory that detects anxiety, depressive and psychotic symptoms, and was completed at baseline and follow up. It has demonstrated suitability for use with Aboriginal Australians and is described in detail elsewhere [18,19]. Items asked about participants' experience of specific psychological symptoms in the past week and response options were 'not much', 'sometimes', 'fair bit', 'lots' or 'no response'.

Cognitive screening tool

Participants completed the CogState computerised test battery at baseline and follow up, which consisted of seven cognitive tasks developed and validated for use with Aboriginal people [20–22]. The tests use playing cards and other game-like stimuli to measure simple

reaction time, visual attention, working memory, visuo-motor function, executive function, learning and memory and paired associate learning.

Follow-up interview

Participants were interviewed at follow up using a standard set of questions regarding their continued use of any substance, the context surrounding their use of petrol and their social situation. This interview was designed for quantitative analysis, so a fixed number of response options were generally presented. If none of the response options was applicable, participants were given the opportunity to provide their own response.

It is understood that self-report questionnaires are subject to a number of limitations, including social desirability response sets and underreporting of consumption. The current research was not exempt from these constraints however, efforts were made to establish a friendly atmosphere, promote honesty and assure participants that any answers given would remain confidential.

Data analysis

The analyses were primarily quantitative and descriptive. Categorical data were described in percentages and relative risk ratios were calculated with Fisher's exact test of significance reported. Means or medians were reported for continuous data, and simple comparisons between individuals who relapsed (relapsing users) and those who maintained abstinence (abstainers) at follow up were conducted using *t*-tests or Mann-Whitney tests for non-parametric data. Because of some cells with zero frequencies, response categories for each of the psychological items were collapsed to form dichotomous variables with responses of 'not much' categorised as a 'negative' response and responses of 'sometimes', 'fair bit' and 'lots' categorised as a 'positive' response.

Results

Of the 56 participants assessed at baseline, 45 (80%) were reassessed an average of 9 months ($SD = 4$) after treatment. Twenty-one (37%) were reinterviewed personally and proxy assessments provided continued substance use information for the remaining 24 (43%). Of the 11 (20%) lost to follow up, seven were male and four were female. One female was deceased. Of those reassessed, 26 (58%) had relapsed and 19 (42%) had abstained from further petrol sniffing. In addition, 34 (75%) were using either cannabis, alcohol or both at follow up. Categorical and continuous variables are

presented in Tables 1 and 2, respectively, comparing relapsing users and abstainers.

Significant relationships were found between relapse and easy accessibility to petrol, being unmarried, living in urban centres and living with fewer people at follow up ($P < 0.05$). Relapsed users were significantly less likely than abstainers to report friends influence as a reason for attending treatment ($P < 0.05$). Possible relationships between relapse with sniffing in response to negative affect, sniffing feeling bad, feeling lonely at baseline, having trouble sleeping at follow up, using both alcohol and cannabis at follow up, using petrol within 14 days prior to treatment, starting sniffing at an earlier age and spending fewer days in treatment were indicated by *P*-values less than 0.10 on these variables (see Tables 1,2).

For the cognitive data, univariate comparisons showed that relapsing users had faster performance on the reaction time [$t_{(41)} = 2.09$; $P = 0.04$] and paired associate learning tasks [$t_{(39)} = 2.16$; $P = 0.04$] at baseline compared with abstainers. There were no other significant differences in cognitive performance between the two groups.

Of those followed up, 28 (62%) did not complete the treatment program. Reasons given for leaving prior to completion included six who returned to their community for a funeral, one was caught using cannabis and four dropped out/ran away (other reasons unknown).

During the follow-up interview, two open ended questions were asked: 'what would make it easier to stop sniffing' and what 'helped you stop sniffing'. Family support was commonly mentioned as an important factor. The influence of friends or other sniffers also featured prominently with common responses, including 'getting away from other sniffers' or 'if friends stopped sniffing'. Attending treatment was also reported to help or make it easier to stop.

Discussion

This is one of few studies internationally to investigate prospectively the factors contributing to continued petrol sniffing following treatment [15]. While exploratory in nature and limited by a small sample size, the study has yielded some valuable data. The group examined appeared to share characteristics of Aboriginal petrol sniffers defined in existing literature [1,23, Winch *S et al.*, unpublished]. Participants were youth engaged in delinquent behaviour (in trouble with the law; 45%), who sniffed in groups (95%), primarily because they were bored (76%) or because of peer pressure (57%), with more males (82%) than females engaging in the practice. The average age of first petrol use was 13 years. These results align with established profiles of Aboriginal solvent users and similar studies of petrol

Table 1. Comparisons between relapsing users and abstainers on categorical variables

	Relapsing users <i>n</i> (%)	Abstainers <i>n</i> (%)	RR	95% CI	<i>P</i> -value ^a
Demographic and sociocultural factors	<i>n</i> = 26	<i>n</i> = 19			
‘Sniffable’ petrol easily accessible	21 (81)	9 (47)	1.7	1.02–2.84	0.021*
Mandated to treatment	5 (21 ^b)	3 (17 ^b)	1.3	0.34–4.56	0.527
Male	22 (85)	15 (79)	0.7	0.21–2.56	0.456
Unemployed at baseline	20 (77)	12 (75)	0.9	0.31–2.78	0.585
Attends Aboriginal ceremony	16 (70 ^b)	7 (50 ^b)	0.4	0.77–2.51	0.200
Live remote	12 (77)	19 (100)	—	—	0.028*
Psychological factors at baseline	<i>n</i> = 26	<i>n</i> = 19			
Sleep problems	11 (61 ^b)	14 (82 ^b)	0.7	0.48–1.14	0.155
Problems thinking	13 (54 ^b)	10 (53)	1.2	0.58–1.81	0.582
Feel angry	11 (46 ^b)	9 (47)	1.0	0.51–1.84	0.582
Feel worried	9 (37.5 ^b)	5 (28 ^b)	1.4	0.55–3.34	0.373
Feel sad	11 (48 ^b)	8 (42)	1.1	0.58–2.24	0.477
Hear voices	8 (33 ^b)	2 (11 ^b)	2.8	0.69–11.72	0.111
Feel lonely	16 (64 ^b)	7 (37)	1.7	0.90–3.35	0.069**
Feel like too much trouble	2 (8 ^b)	1 (5)	1.5	0.15–15.55	0.604
Psychological factors at follow up	<i>n</i> = 15	<i>n</i> = 13			
Sleep problems	10 (67)	3 (27 ^b)	2.4	0.87–6.84	0.055**
Problems thinking	4 (27)	3 (27 ^b)	1.0	0.27–3.51	0.655
Feel angry	5 (38.5 ^b)	4 (33 ^b)	1.2	0.40–3.31	0.560
Feel worried	3 (20)	3 (25 ^b)	0.8	0.19–3.27	0.557
Feel sad	5 (33)	4 (33 ^b)	1.0	0.34–2.93	0.657
Hear voices	4 (27)	2 (15)	1.7	0.38–7.98	0.400
Feel lonely	6 (40)	3 (25 ^b)	1.6	0.50–5.10	0.343
Feel like too much trouble	3 (20)	4 (33 ^b)	0.6	0.17–2.18	0.364
Substance use factors	<i>n</i> = 19	<i>n</i> = 16			
Using both cannabis and alcohol at follow up	12 (67 ^b)	6 (37.5)	1.8	0.87–3.62	0.087**
Sniffing 14 days before treatment	17 (89.5)	6 (60 ^b)	1.5	0.87–2.53	0.086**
Interview data	<i>n</i> = 13	<i>n</i> = 10			
Sniff because bored	9 (69)	7 (87.5 ^b)	0.8	0.51–1.24	0.344
Sniff because of friends	8 (61.5)	4 (50 ^b)	1.2	0.55–2.78	0.604
Sniff response to affect	9 (69)	2 (25 ^b)	2.8	0.79–9.70	0.063**
Sniff because ran out of other drug	3 (23)	1 (12.5 ^b)	1.9	0.23–14.84	0.502
Sniff with others	12 (92)	8 (100 ^b)	—	—	0.619
Sniffing feels bad	9 (69)	2 (25 ^b)	2.8	0.79–9.70	0.063**
Had injuries from sniffing	5 (38.5)	3 (37.5 ^b)	1.0	0.33–3.17	0.664
Attitude to sniffing before treatment					
No good	6 (54.5 ^b)	3 (37.5 ^b)	1.5	0.51–4.13	0.395
Attitude to sniffing after treatment					
No good	11 (92 ^b)	9 (100 ^b)	—	—	0.571
Reasons for attending treatment					
Own decision	7 (58 ^b)	7 (78 ^b)	0.8	0.41–1.36	0.324
Family influence	5 (42 ^b)	5 (56 ^b)	0.8	0.31–1.82	0.425
Friend influence	0 (0 ^b)	4 (44 ^b)	—	—	0.021*
Community pressure	3 (25 ^b)	1 (11 ^b)	2.3	0.28–18.22	0.414
School reasons	3 (25 ^b)	1 (11 ^b)	2.3	0.28–18.22	0.414
Health reasons	2 (17 ^b)	1 (11 ^b)	1.5	0.16–14.08	0.612
Learnt about effects	0 (0 ^b)	1 (11 ^b)	—	—	0.429
Trouble with the law	6 (54.5 ^b)	3 (33 ^b)	1.6	0.56–4.77	0.311
Married	0 (0)	4 (44 ^b)	—	—	0.017*
Finished treatment program	4 (36)	4 (40)	0.9	0.31–2.70	0.608

* $P < 0.05$; ** $P < 0.10$. ^aFisher’s exact test. ^bPercentage calculated based on reduced *n* as a result of one to five participants with missing data on this variable. CI, confidence interval; RR, risk ratio.

Table 2. Comparisons between relapsing users and abstainers on continuous variables

	Relapsing users Mean (SD) (n = 26)	Abstainers Mean (SD) (n = 19)	df	T statistic	P-value
Sociocultural and demographic factors					
Age	17.38 (3.63)	20.06 (6.92)	26 ^a	-1.54	0.136
Education	7.92 (1.96)	7.74 (2.60)	42	-0.27	0.791
No. of days in treatment	32.28 (18.30)	44.06 (20.73)	35	1.83	0.076**
No. of people living in the house	6.3 (1.94)	8.57 (2.15)	14	2.19	0.046*
	Median	Median		Z statistic	P-value
Substance use factors					
No. years using petrol at baseline	4.00	5.5	—	-0.77	0.444
No. years using cannabis at baseline	1.00	0.97	—	-0.19	0.851
No. years using alcohol at baseline	0.5	0	—	-0.97	0.332
Age 1st used petrol	12.00	14.00	—	-1.90	0.058**
Age 1st used cannabis	15.00	16.00	—	-0.86	0.387
Age 1st used alcohol	14.50	16.00	—	-1.61	0.108

* $P < 0.05$; ** $P < 0.10$. ^aEqual variances not assumed.

sniffing patterns in remote communities [1,15,23, Winch S *et al.*, unpublished]. Findings suggested that petrol availability, peer pressure and social disengagement may be important risk factors for relapse following treatment. Other findings with P -values less than 0.10 suggested that psychologically distressed individuals, with more severe substance use histories, including starting at a younger age and using multiple substances, might also be more likely to relapse; however, further research in a larger sample is required to confirm these associations.

A key factor significantly influencing relapse was petrol availability. Relapsed users were almost twice as likely to return to a community where sniffable petrol was readily available compared with abstinent users. 'Opal' fuel is a low aromatic fuel replacement recently introduced as a supply reduction strategy in petrol sniffing-affected regions of Australia. The significant success of the fuel in reducing the impact of petrol sniffing in remote Aboriginal communities is also reflected in the current results [24]. Nevertheless, some individuals returning to a community with Opal fuel did continue sniffing at follow up. This could reflect differences between communities in their attitudes or ability to respond to sniffing, as community resolve and support have been suggested as important accompanying elements in the success of fuel replacement strategies [14]. Some Australian studies suggest that petrol sniffing is seen by some users as an opportunity to define their identity, belong to a social group, resist authority or create a sense of power in an otherwise powerless environment [6,25,26, Winch S *et al.*, unpub-

lished]. Future cross-sectional surveys could examine community and peer group attitudes towards sniffing to determine the potential social acceptability of the practice and its impact on petrol sniffing behaviours.

Solvent abuse often occurs in the context of a disrupted family structure, child abuse or other social stressors [1,27, Winch S *et al.*, unpublished]. Relapsing users in this study were more likely to sniff in response to negative affect and experience psychological symptoms, such as feelings of loneliness at baseline and trouble sleeping at follow up; however, these results just failed to reach statistical significance ($P < 0.10$). While feelings of loneliness may relate to their potential social isolation (i.e. unmarried and living with fewer people) they might equally relate to a poorer ability to cope with isolation during treatment compared with abstinent users. These findings compliment those of another study identifying a lack of family support and high levels of stress as common reasons to begin sniffing [Winch S *et al.*, unpublished]. However, future research is needed to confirm and further examine any relationships between psychological distress and petrol sniffing behaviour, using a more in-depth assessment process based on comprehensive clinical interviews.

The apparent psychosocial differences between relapsing users and abstainers may reflect observed differences in other studies between occasional and heavy users. One study found that peer influence was the most common reason for sniffing given by light users, but heavy users were more likely to sniff in response to affect [28]. In the current study, abstainers appeared more likely to be influenced by friends than relapsed

users. Additionally, relapsed users continued to sniff despite a slightly greater proportion ($P = 0.06$) reporting that it felt bad, compared with abstainers, suggesting addiction. Furthermore, more severe solvent use, which included starting at a younger age, sniffing immediately prior to treatment and poly substance use, also appeared to be associated with relapse, although these factors just failed to reach statistical significance ($P < 0.10$). A similar, retrospective study of relapse rates in Canadian solvent users identified sniffing immediately prior to rehabilitation as a significant risk factor for continued solvent use 2 years after treatment [15]. While this factor failed to reach statistical significance here, it may be that our small sample size meant that we lacked sufficient power to reliably detect such associations. Future research in a larger sample is therefore warranted.

Attendance at treatment appeared to produce a change in attitude towards sniffing, with 90% of those followed up reporting that they thought sniffing was no good after attending treatment compared with 47% before treatment. While this result may reflect a social desirability response set [29] (as both responses were given at follow up), it might equally reflect increased knowledge of the health effects of sniffing presented during treatment. Nevertheless, despite this reported attitude change, 58% of participants continued use after treatment. This outcome may reflect the poor treatment completion rates with relapsing users spending slightly fewer days in treatment than abstainers, although this finding failed to reach statistical significance ($P = 0.08$). Actually, both groups exhibited poor treatment completion rates, which may relate to the urban location of two of the rehabilitation centres. The most common reason for leaving treatment early was to return home for a funeral. Recent studies suggest that effective petrol sniffing interventions should be both multifaceted and community-based [14,30]. Nevertheless, an important aspect of urban-based residential treatment programs might be to increase awareness of potential risk factors to improve resilience and coping mechanisms among petrol sniffers and reduce their susceptibility to further petrol abuse upon return to their communities.

While this study was exploratory and descriptive in nature, aiming to highlight potential psychosocial and environmental risk factors for continued use, its findings must be considered in light of several limitations. Given the small sample size, and the large number of statistical comparisons, the risk for type 1 error may be substantial. Future research in a larger sample under more controlled conditions is warranted in order to confirm the associations found here and identify the most important predictors of relapse, although, this may be difficult for this population [31]. The current study assessed a vast majority of youth attending treat-

ment for petrol sniffing in the Northern Territory over 3 years, and followed up approximately 80% of these at great time and logistical expense. In the absence of larger, more controlled studies, this research provides important indicators for treatment providers, policy makers and researchers to consider in managing and understanding the impact of petrol sniffing for Aboriginal Australians.

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