

# Challenges in Accurately Assessing Prenatal Alcohol Exposure in a Study of Fetal Alcohol Spectrum Disorder in a Youth Detention Center

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**Background:** Prenatal alcohol exposure (PAE) can result in permanent disability, including physical, neurodevelopmental, and cognitive impairments, known as fetal alcohol spectrum disorder (FASD). Individuals with FASD are more likely to engage with the law, including being placed in detention, than individuals without FASD. Young people who were sentenced to detention participated in a FASD prevalence study in Western Australia. The diagnosis of FASD requires a multidisciplinary assessment and confirmation of maternal alcohol consumption during pregnancy. Obtaining accurate assessment of PAE for young people participating in the study was challenging.

**Methods:** An interview with the birth mother or other responsible adult for young people sentenced to detention in Western Australia was conducted as part of the FASD assessment. The Alcohol Use Disorders Identification Test consumption subset (AUDIT-C), other relevant questions, and documentary evidence were used to assess PAE. PAE was categorized according to the Australian Guide to the Diagnosis of FASD: no PAE reported, confirmed or confirmed high-risk, or unknown.

**Results:** Among the 101 participants, information on PAE was unable to be obtained for 13 (13%) young people. Of the remaining 88 participants with information of PAE, 41 reported no PAE and 47 had confirmed PAE.

**Conclusions:** Accurately assessing prenatal alcohol consumption is challenging in any setting, but it is exceptionally challenging when assessed 13 to 17 years retrospectively as part of a FASD assessment for a young person sentenced to detention. Recording and recoding detailed qualitative responses was required to provide an accurate assessment of PAE using the AUDIT-C. Standardized recording of PAE in antenatal and birth records would facilitate later assessments for FASD and provide opportunities for advice and support for women who continue to drink during pregnancy.

**Key Words:** Assessing, Prenatal Alcohol Exposure, Fetal Alcohol Spectrum Disorder, AUDIT-C, Challenges.

**P**RENATAL ALCOHOL EXPOSURE (PAE) can result in permanent disability in the child, including physical,

neurodevelopmental, and cognitive impairments, known as fetal alcohol spectrum disorder (FASD). The diagnosis of FASD requires multidisciplinary assessment and disclosure or other confirmation of maternal alcohol consumption during pregnancy (Bower and Elliot, 2016; Chasnoff et al., 2015). The severity of fetal outcomes is linked to the timing, frequency, and quantity of PAE, but this information may not be attainable or reliable (Astley, 2011; Bower and Elliot, 2016; Feldman et al., 2012).

Although young people are at a high risk of contact with the justice system when there is maternal alcohol misuse (Australian Institute of Family Studies, 2015; Carr and Vandiver, 2001; Hafekost et al., 2017), little has been written about the assessment of PAE among young offenders specifically for a FASD diagnosis. The only 4 studies of FASD prevalence in youth justice were all from Canada. Two of these studies did not report how PAE information was collected (Fast et al., 1999; Murphy and Chittenden, 2005; Rojas and Gretton, 2007; Smith et al., 2013). One study included cases of diagnosed fetal alcohol effect (FAE) or fetal alcohol syndrome (FAS) or suspicion of FAE or FAS, by review of case files, with no

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Received for publication May 29, 2018; accepted November 3, 2018.

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DOI: 10.1111/acer.13926

information reported on assessment of PAE (Rojas and Gretton, 2007). Fast and colleagues (1999) obtained a confirmed prenatal alcohol history from either the youth, caregivers, parents, birth medical records, or other collateral sources.

Evidence of PAE may include self-reports by the birth mother, reports by others, including a partner, family, or community member who directly observed maternal alcohol consumption during the pregnancy or documented recording of maternal alcohol consumption in medical, child protection, legal, or other reports.

Assessing PAE for young people engaged in the justice system may be complex for several reasons including limited contact with birth mothers and long period of elapsed time since the birth, resulting in retrospective recall bias or inaccurate retrospective ascertainment (Alvik et al., 2006). Another concern is the possibility of underreporting (Lange et al., 2014). Asking sensitive questions such as the consumption of alcohol during pregnancy may also elicit lower self-reports and lower response rates which may increase reporting errors of socially stigmatizing behavior (Roger and Ting, 2007; Schroder et al., 2003).

Further limitations may occur if birth mothers have English as an additional language or low literacy levels for self-completed assessments (McHugh et al., 2014).

There are a number of validated screening instruments to assess alcohol use for pregnant women including the Alcohol Use Disorders Identification Test consumption subset (AUDIT-C) (Chiodo et al., 2010; Russell, 1994; Sokol et al., 1989). The AUDIT-C has been validated as a sex-specific tool to estimate alcohol consumption in pregnant women in a standard, meaningful, and nonjudgmental manner, though no level of validation will ensure accurate reporting will take place (Bower and Elliot, 2016; Bush et al., 1998; Chiodo et al., 2010; Dawson et al., 2005; Lopez et al., 2017; Russell, 1994; Sokol et al., 1989). The AUDIT-C is the recommended method of assessing PAE for FASD diagnosis in the Australian Guide to the Diagnosis of FASD (Bower and Elliot, 2016); however, it has not been validated in Indigenous Australian populations.

Reliable confirmation and quantification of alcohol exposure during pregnancy is necessary to prevent misclassification of exposure, but this can be challenging. This paper describes the challenges of accurately assessing PAE as part of a FASD assessment for young people who are sentenced to detention.

## MATERIALS AND METHODS

All young people who were aged between 10 and 17 years 11 months with a minimum 2-week sentence to detention at Banksia Hill Detention Centre, the only youth detention center in Western Australia, between May 2015 and November 2016 were eligible to participate in a study to estimate the prevalence of FASD (Bower et al., 2018). The Centre's census was used to identify eligible young

people. The project research officer first sought assent from the young person explaining the project with simple terms and a pictorial information flyer and assent form which included information on the aim of the study to identify how many young people had FASD and what participation was involved. If the young person provided written assent, then their responsible adult was contacted and required to provide written consent for their young person's participation. Of the eligible young people approached, 93% (154) assented to participate and 73% (113) of their responsible adults provided written consent (Bower et al., 2018). The consent form included optional components including approval to access school, health, and legal records of the young person, and birth mothers could consent to the research team accessing medical records of their pregnancy and birth, if required. Participants and their responsible adults were informed that participation in this study would not alter the young person's current sentence. Upon completion of the assessments, the young person was provided with a certificate of completion. The responsible adult was provided with feedback from the clinical assessments by 1 or more of the clinicians and a written report with the results, identified strengths and difficulties, and strategies to address the difficulties. Upon guidance from the responsible adult, the young person then received their feedback. The methods used are described in detail in the protocol paper (Passmore et al., 2016).

A 72-item interviewer-administered questionnaire was developed to obtain demographic and biomedical data from the participant's responsible adult. The interview included questions about the child's birth and neonatal history, maternal history, prenatal exposures (medications, alcohol and illicit drugs, and including the 3 AUDIT-C questions), early childhood growth and development, education, and other social factors including involvement with services providers. The questionnaire was administered by a research officer with experience in remote area nursing and midwifery. On most occasions, the interview was administered by telephone, and to increase reporting accuracy, participants were assured that their responses would remain confidential and that the information collected would be deidentified.

The young person's birth mother was first sought to complete the interview. If she was not available, then we sought to complete the interview with a relative with firsthand knowledge of the birth mother's pregnancy with the young person. If the birth mother or a relative was not available to complete the interview, other sources of evidence to confirm or rule out PAE were sought.

The AUDIT-C has 3 short questions regarding frequency, number of standard drinks, and consumption of 5 or more drinks on 1 occasion. Each question has 5 responses and receives a score between 0 and 4. The scores are combined for each question resulting in a total score that matches a risk of harm (Bush et al., 1998; Murdoch Children's Research Institute, 2010; Appendix 1).

Standard prompts were used to increase accuracy of assessing PAE and assist with estimation of standard number of drinks that may have typically been consumed. These included asking the participant about their usual choice of drink with further prompts including the type (beer, wine, or spirits), strength, brand of alcohol, or color of can as some types of cans are known by the color of their packaging (Lee et al., 2018) and size (shots, glass, can, bottle, cask<sup>1</sup>). Participants were also prompted for method of preparation, whether the drink was premixed or not. Using this information, a score for each item of the AUDIT-C was assigned where possible (Appendix 2).

PAE was categorized according to the Australian Guide to the Diagnosis of FASD as follows: (i) no exposure with reported absence of prenatal alcohol (AUDIT-C score = 0); (ii) confirmed exposure if either the AUDIT-C score was between 1 and 4 or it was reported that alcohol was consumed during the pregnancy, but it was not known whether it was exposed at high-risk level; (iii) confirmed high-risk exposure if either the AUDIT-C score was 5 or more or it was reported that exposure was at a high level; or (iv) unknown, if there was no information available to confirm or exclude PAE (Bower and Elliot, 2016).

Respondents were asked whether alcohol was consumed during each trimester of the pregnancy. Where possible, standard drink equivalents were estimated from the participant's responses to questions regarding the number, type, and size of drinks containing alcohol consumed.

When the participant responses were unable to be coded directly using the AUDIT-C, these responses were recorded verbatim. Some more common responses were coded using the following: "special occasions," which occurred monthly or less, were scored 1; and "pay week," which occurred every 2 weeks ("fortnightly"), received a score of 2. This is comparable to methods used in a FASD prevalence study using a modified AUDIT-C questionnaire which included "fortnightly" with this response receiving a score of 2 (Fitzpatrick et al., 2015).

Additional questions asked the participant at what point in time the birth mother acknowledged she was pregnant and whether the birth mother modified her drinking on confirmation of pregnancy. The participants were asked to rate how confident they were with their responses to the AUDIT-C questions with the following options: "very sure," "fairly sure," and "not so sure." The research officer allocated a source code dependent upon who was interviewed or from where the PAE information was obtained. Birth mothers and documented PAE were a primary source, and secondary sources were family, friends, or relatives who directly observed the consumption of alcohol during pregnancy of the young person.

Data were analyzed in SPSS Statistics 24.0 (IBM Corp., Armonk, NY). Descriptive statistics were calculated for the sociodemographic profiles of both the participants and the sources of PAE information where available. Individual AUDIT-C questions were also reviewed simultaneously to investigate the completeness and reliability of the data.

## RESULTS

### Participation

A total of 113 young people assented and were consented to participate in the FASD prevalence study. Five participants were released from the detention center before commencing assessment, and 7 withdrew before completing assessment. PAE information was not able to be collected for these 12 young people. PAE information was not able to be located for 13 of the remaining 101 young people; therefore, their PAE was categorized as unknown.

The majority of the 88 young people with information on PAE identified as being Aboriginal (70%), were male (92%), and resided in the metropolitan area (50%). Participants had an average age of 16 years at consent.

In terms of age, gender, and Aboriginality, the 13 young people with unknown PAE were similar to the participants, and to the overall population in the detention center at the time of the study.

The birth mother provided information on PAE for 55 (63%) of the 88 young people with a source of PAE. The other remaining sources of PAE were mostly relatives, primarily the father 10 (11%) or grandmother 9 (10%), with documentary evidence of PAE being the only available source for 5 young people.

Among the 88 with a source of PAE, the AUDIT-C assessment was able to be completed for 70 (80%). This included either reports of no PAE or answering all 3 AUDIT-C questions. Birth mothers (49) and fathers (8) were most likely to complete the AUDIT-C assessment (89 and 80%, respectively). For the remainder, PAE was able to be categorized using partial AUDIT-C information ( $n = 7$ , 8%) where frequency or quantity of prenatal alcohol consumption was

**Table 1.** Level of Completion of the AUDIT-C Instrument<sup>a</sup> by PAE Informant Type

PAE informant	Full assessment <i>n</i> (%)	Partial assessment <i>n</i> (%)	PAE confirmation only <i>n</i> (%)	Total <i>n</i> (%)
Birth mother	49 (89)	2 (4)	4 (7)	55 (63)
Other relative	12 (67)	2 (11)	4 (22)	18 (20)
Father	8 (80)	1 (10)	1 (10)	10 (11)
Documented evidence	1 (20)	2 (40)	2 (40)	5 (6)
Total	70 (80)	7 (8)	11 (12)	88 (100)

PAE, prenatal alcohol exposure.

<sup>a</sup>Full assessment: information on quantity and frequency of PAE obtained. Partial assessment: information on quantity or frequency obtained.

<sup>1</sup>Cask is wine contained in a plastic bladder within a cardboard box and may hold up to 4 l of wine.

reported or there was unquantified confirmation of prenatal alcohol consumption ( $n = 11$ , 12%; Table 1).

### Prenatal Alcohol Exposure

Among the 113 eligible subjects, information on PAE could not be obtained on 25 (12 withdrew consent or were released, and 13 had unknown PAE). Of the 88 young people with information on PAE, 41 (47%) had no reported PAE, 19 (22%) had either unknown or moderate-quantity PAE, and 28 (32%) reported PAE at high-risk levels (Table 2).

Where PAE was reported, 70% reported alcohol use across all 3 trimesters of the pregnancy. Alcohol consumption was high within each trimester when any PAE was reported: 93% in the first trimester, 90% in the second trimester, and 84% in the third trimester (Table 3).

### Reported Levels of Confidence in Recall of PAE

The source of PAE was obtained from a primary source in 84 (95%) cases. Documentary evidence was the only source of information on PAE in 5 (5%) cases. Most participants ( $n = 67$ , 81%) were “very sure” and 16 (19%) “fairly sure” about their recollection and report of alcohol use or abstinence during the pregnancy (Table 4).

### Frequency of Consuming a Drink Containing Alcohol

Most women (47; 54%) consumed a drink containing alcohol during pregnancy. In the 47 cases where PAE was reported, the most common patterns were consuming a drink containing alcohol 2 to 4 times a month (15%) and monthly or less (10%).

Seven responses did not fall directly into the AUDIT-C specified responses. These responses included “every fortnight when it was pay week,” “drank at least every fortnight when we got paid,” and “pay days.” These responses were coded as 2 to 4 times per month and allocated a score of 2 (Table 3).

### Number of Standard Drinks Containing Alcohol Consumed on a Typical Day When Drinking During Pregnancy

The most common reported number of standard drinks containing alcohol consumed on a typical day during pregnancy was 7 to 9 drinks (26%). The least common response

**Table 3.** Reported PAE by Trimester and for Each AUDIT-C Question

	<i>n</i> (%)
PAE by trimester	
Trimester 1	40 (93)
Trimester 2	39 (90)
Trimester 3	36 (84)
Total*	43 (100)
Frequency of alcohol consumption during pregnancy	
Monthly or less	10 (21)
2 to 4 times per month	15 (32)
2 to 3 times per week	8 (17)
4 or more times per week	2 (4)
Unknown	12 (26)
Total	47 (100)
Number of standard drinks on a typical day	
1 or 2 drinks	2 (4)
3 or 4 drinks	7 (15)
5 or 6 drinks	8 (17)
7 to 9 drinks	12 (26)
10 or more drinks	4 (8)
Unknown	14 (30)
Total	47 (100)
Frequency of 5 or more drinks on 1 occasion	
Never	1 (2)
Less than monthly	4 (9)
Monthly	15 (32)
Weekly	10 (21)
Don't know	17 (36)
Total	47 (100)

\*PAE trimester information unknown for 4 young people.

**Table 4.** Source of PAE Information and Self-Reported Confidence Levels

Source of PAE information	Self-reported confidence levels		
	Very sure <i>n</i>	Fairly sure <i>n</i>	Total <i>n</i> (%)
Birth mother	50	5	55 (63%)
Informant directly observed PAE	15	9	24 (27%)
Informant did not directly observe but has indirect knowledge of PAE	2	2	4 (5%)
Birth mother's PAE for young person documented	5		5 (6%)
Total	72	16	88 (100%)

was 10 or more standard drinks (4%). However, most respondents (30%) were unable to quantify this number. In these circumstances, additional questions were asked in order to estimate the number of drinks consumed on a typical day when drinking during pregnancy. Using details including drink size, color, type, or brand, the number of standard drinks was estimated. Some of the responses included “I have a few” and with further questioning identified the consumption of a 6-pack of premixed spirits which equated to at least 9 standard drinks and allocated a score of 3. “I'm sharing two to three cartons of beer” was assigned to the response category of 7 to 9 drinks as it was difficult to determine how many people shared the cartons and how many cans of beer were drunk by the participant. “Lots,” with further questioning, was estimated as more than 8 standard drinks, and this

**Table 2.** PAE Finding in Young People With an Informant for PAE and Without an Informant

PAE findings	<i>n</i> (%)	<i>n</i> (%)
Reported no PAE	41 (47)	41 (41)
Confirmed PAE	19 (22)	19 (19)
Confirmed high-risk	28 (32)	28 (28)
Unknown	—	13 (13)
Total	88 (100)	101 (100)

response corresponded to 7 to 9 standard drinks, scoring a 3, and “Quite a few,” with further questioning, corresponded to 10 or more standard drinks and scored a 4.

Some participants shared alcohol with family and community members and did not know how many standard drinks they had consumed typically: “I’d buy a carton and bottle of rum and share this with 4 to 6 people but then those 4 to 6 people would buy a carton and bottles of rum. And we’d drink until it was all gone.” These responses were assigned the consumption of 10 or more standard drinks and scored a 4 (Table 3).

#### *Frequency of 5 or More Drinks Containing Alcohol on 1 Occasion*

The most frequent response to drinking 5 or more drinks containing alcohol on 1 occasion during the pregnancy question was “don’t know” (36%). If PAE was known, drinking 5 or more drinks containing alcohol on 1 occasion most commonly occurred monthly (32%).

Some participants described their state of behavior or used terminology describing binge drinking in response to the question concerning the consumption of 5 or more drinks containing alcohol on 1 occasion. Their responses included “Till I’m blue,” “till I pass out,” and “blind drunk” and were recorded as drinking 5 or more drinks on 1 occasion.

Of the 29 participants who reported that 5 or more drinks containing alcohol were consumed on at least 1 occasion during the pregnancy, 1 participant was only “fairly sure” of their response compared with the 28 participants who were “very sure” of their responses. This participant was assigned the confirmed PAE category rather than the high-risk category (Table 3).

#### *Known Unquantified PAE*

Five birth mothers confirmed PAE but were unable to quantify the exposure. Some birth mothers reported “I didn’t drink when I was in community,” but they were unable to identify when they acknowledged the pregnancy and did not reside in the community for the entire length of the pregnancy. If there was conflicting information between sources, further evidence of PAE was sought and the most conservative level of consumption was accepted. On these occasions, PAE was categorized as confirmed.

Other sources who directly observed the birth mother consuming alcohol during the pregnancy were unable to provide responses to the AUDIT-C question regarding quantity but indicated that consumption was high. Their responses included the following: “she drank through her whole pregnancy,” “she would go out every weekend with her sisters and drink,” “she tried to keep the pregnancy hidden for as long as possible,” and “only drank till she was showing.” “I knew she was drinking but I didn’t think she drank enough” (in order to result in a FASD diagnosis). Some responses provided more information: “She wouldn’t share and drank

only full strength beer. Whatever was available she would drink it.”

For some birth mothers, the research officer determined that asking the AUDIT-C questions was causing further stress and questioning was discontinued. These responses included the following: “Don’t ask me any more questions about alcohol, I have told you I drank,” and “why you asking all these questions, I drank more with my daughter and she’s ok.” Some women explained why they drank during the pregnancy: “It depends on life. There were some stressful times during the pregnancy” (a birth mother). These responses were assigned a confirmed category.

## DISCUSSION

Assessing PAE for young people sentenced to detention as part of a comprehensive FASD assessment was challenging. Although informants were asked systematically about PAE, as recommended by the Australia Guide to the Diagnosis of FASD, based upon a validated assessment tool with additional questions, only 29 of the 47 sources that confirmed PAE provided enough information to complete the 3 AUDIT-C questions.

Furthermore, birth mothers were the respondents in only 63% of cases. Despite many of the responses from informants not corresponding with AUDIT-C options, it was possible to categorize PAE as reported absent, confirmed, or confirmed high-risk in the majority of instances.

Among the 101 young people for whom information on PAE was sought, neither the birth mother nor a relative with firsthand knowledge of the pregnancy or any other documented evidence of PAE was unable to be located for 13 (13%). A recent FASD prevalence study in an adult prison also described obtaining PAE as challenging and difficult to quantify because of maternal recall and because half of the sample had unknown PAE, despite multiple sources available to confirm PAE (McLachlan, 2017).

The proportion of women who did not drink alcohol in pregnancy in this study is similar to that reported in other studies (Fitzpatrick et al., 2015; Halliday et al., 2017; Muggli et al., 2016). However, we found that if alcohol was consumed during the pregnancy, 77% of women continued to drink alcohol throughout all 3 trimesters of the pregnancy where other studies reported fewer women continued to drink once they realized they were pregnant (Callinan and Ferris, 2014; Ethen et al., 2009; Mallard et al., 2013; McCormack et al., 2017; Muggli et al., 2016).

Obtaining an accurate measure of PAE that is reliant on maternal recall and self-report is likely to be limited due to varying amounts of suspected underreporting (Eichler et al., 2016; Lange et al., 2014). Many participants were unable to or unwilling to respond to the quantity component of the AUDIT-C, with self-reporting also limited by poor understanding of a standard drink measurement (Smith et al., 2014). A clear understanding of what constitutes a standard drink may have increased our estimates of the quantity of

standard drinks consumed and the accuracy in self-reporting PAE as has been noted by others (Bergen-Cico and Kilmer, 2010).

Other research assessing drinking patterns of women has identified that supplying images of drink choices facilitated increased reporting accuracy. However, as our interviews were conducted by telephone, it was not possible to use images of local drinks in varying sizes and strengths to prompt or increase accuracy (Muggli et al., 2010, 2015).

Our use of a telephone interview may have increased the accuracy of self-reports as it may enhance anonymity and confidentiality which can promote accurate self-reports of alcohol in pregnancy (Muggli et al., 2010, 2015).

Participants reported sharing alcohol which makes it challenging to accurately assess an individual's alcohol consumption. The common practice of sharing alcohol among drinkers may also limit accurate reporting of quantity and frequency of alcohol consumption (Kowalyszyn and Kelly, 2003). Kowalyszyn and Kelly's (2003) study assumed that the amount of alcohol bought to a gathering was shared and consumed until finished was the amount of alcohol consumed. Lee and colleagues (2018) found that clients report what the whole group had to drink rather than what was consumed independently. The use of the Grog Survey app can assist individuals to work out how much they themselves drank in a drinking group (Lee et al., 2018). We also assumed that the amount of alcohol they brought was shared among group members, but if this was not the case, then we will have underreported PAE. Some respondents also only reported drinking fortnightly when they were paid and the purchaser of the alcohol. It is possible alcohol was consumed when they were not the purchaser of alcohol, and if this is the case, we will have again underreported PAE.

Self-reporting PAE as part of a FASD assessment may be influenced by social stigma and retrospective recall bias (Eichler et al., 2016). Assessing PAE for a pregnancy 10 to 17 years ago may be less accurate as a result of the extended time period since exposure, though other studies on recalling PAE indicate that retrospective reporting of alcohol use in pregnancy has been reported to yield higher and possibly more accurate information than reporting during pregnancy (Alvik et al., 2006; Hannigan et al., 2010).

As the collection for PAE was part of a FASD assessment for young people in detention, there may also have been an element of shame in quantifying alcohol consumption during pregnancy. This may explain why some birth mothers and other relatives reported that no alcohol was consumed. The element of public stigma, shame, and blame that can be associated with FASD may give rise to hesitancy in the respondent to answering the AUDIT-C question (Corrigan et al., 2017; Poole, 2008). Where this hesitancy was observed, we accepted categorical confirmation of PAE rather than seeking detailed measures of frequency and quantity of alcohol, as this level of quantification is sufficient for diagnosing FASD according to the Australian Guide (Bower and Elliot, 2016).

Although obtaining information on PAE from a participant's grandparents, caregivers, and child protection records may not be directly comparable to that obtained from birth mothers, other informants were the only source of information about PAE for many of the young people in this study. Only 1 of the 4 other reported studies of FASD prevalence in justice settings used active case ascertainment with clinical assessment of young people (Fast et al., 1999), and their description of how they ascertained PAE is limited. The other 3 used reporting of FASD in the young persons' records or self-report of FASD by the young person themselves (Fast et al., 1999; Rojas and Gretton, 2007; Smith et al., 2013), with no mention of how PAE was assessed. Despite the limitations and challenges we encountered in our study, we attempted to be rigorous in seeking confirmation of PAE and were conservative in assigning PAE based on the strength of the evidence obtained.

Accurately assessing prenatal alcohol consumption is challenging in any setting, but it is exceptionally challenging when collected 10 to 17 years retrospectively and as an adjunct for a FASD assessment for a young person sentenced to detention. Quantified PAE using the AUDIT-C is recommended in the national guide for diagnosing FASD; however, in this population it was challenging to accurately assess PAE without recoding and recording qualitative data. Standardized recording of PAE on all antenatal birth records would facilitate later assessment for FASD and provide opportunities for advice and support for women who continue to drink.

## APPENDIX 1: AUDIT-C Questions

Questions	Scoring system					Score
	0	1	2	3	4	
How often do you have a drink containing alcohol?	Never	Monthly or less	2 to 4 times per month	2 to 3 times per week	4+ times per week	
How many standard drinks of alcohol do you drink on a typical day when you are drinking?	1 to 2	3 to 4	5 to 6	7 to 9	10+	
How often do you have 5 or more drinks on 1 occasion?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	

## APPENDIX 2: Questions Used to Assess Patterns of PAE Using the AUDIT-C Scoring System

How often did you/the birth mother have a drink containing alcohol before the pregnancy with (insert name)?	Never [0], Monthly or less [1], 2 to 4 times/month [2], 2 to 3 times/wk [3], 4 or more/wk [4], Don't know
How often did you/the birth mother have a drink containing alcohol during the pregnancy with (insert name)?	Never [0], Monthly or less [1], 2 to 4 times/month [2], 2 to 3 times/wk [3], 4 or more/wk [4], Don't know
How many drinks did you/birth mother have on a typical day when you/they were drinking before the pregnancy with (insert name)?	1 or 2 [0], 3 or 4 [1], 5 or 6 [2], 7 or 9 [3], 10 or more [4], Don't know
How many drinks did you/birth mother have on a typical day when you/they were drinking during the pregnancy with (insert name)?	1 or 2 [0], 3 or 4 [1], 5 or 6 [2], 7 or 9 [3], 10 or more [4], Don't know
When did the birth mother realize that she was pregnant?	
Did the birth mother modify her drinking behavior on confirmation of pregnancy?	
If you can remember, what was your/birth mothers usual drink of choice at the time?	
Prompt; for type, full strength, brand	
Prompt for size; shot, glass, bottle, can, cask	
How often did you/birth mother have 5 or more drinks on 1 occasion prior to the pregnancy with (insert name)?	Never [0], less than monthly [1], monthly [2], weekly [3], daily/almost daily [4], Don't know
How often did you/birth mother have 5 or more drinks on 1 occasion during to the pregnancy with (insert name)? <sup>a</sup>	Never [0], less than monthly [1], monthly [2], weekly [3], daily/almost daily [4], Don't know
During which 3 months of pregnancy was any alcohol consumed?	First 3 months, middle 3 months, last 3 months, don't know, none
I know it might be hard to remember about drinking alcohol before (insert name) was born. Can you say how sure you are about what you've told me today?	Very sure, fairly sure, not so sure

<sup>a</sup>The AUDIT-C uses 6 or more drinks, but using the Australian FASD guidelines, it is 5 or more standard drinks on 1 occasion.

## ACKNOWLEDGMENTS

The authors extend their thanks and respect to every birth mother, birth father, grandparent, and family member who offered their trust in sharing their personal stories with the research team. Their willingness to share personal information about their life circumstances proved humbling. This research would not have been possible without their engagement, and for this, the authors are grateful. The authors also thank the young people at Banksia Hill Detention Centre involved in the study for their participation and support. The authors thank the Department of Justice and the Department of Communities (formally known as the Department for Child Protection and Family Support) for their support and acknowledge their staff members involved with the study including all staff based at Banksia Hill Detention Centre. Any material published or made publicly available by the authors cannot be considered as either endorsed by the Department of Justice or an expression of the policies or view of the Department. Any errors of omission or commission are the responsibility of the researchers.

## FUNDING

This work was supported by National Health and Medical Research Council (NHMRC) targeted call for research grant (#1072072). The authors declare no conflicts of interest.

## ETHICS APPROVAL

Ethics approval was given by Western Australian Aboriginal Health Ethics Committee (approval number 582) and the University of Western Australia Human Research Ethics Committee (approval number RA/4/1/7116). The former Department of Corrective Services granted research

approval (DCS; project ID 335). The former Department for Child Protection and Family Support (DCPFS) also gave approval for the research to include young people in their care (approval number 2015/8981).

## REFERENCES

- Alvik A, Haldorsen T, Groholt B, Lindemann R (2006) Alcohol consumption before and during pregnancy comparing concurrent and retrospective reports. *Alcohol Clin Exp Res* 30:510–515.
- Astley S (2011) Diagnosing fetal alcohol spectrum disorders (FASD), in *Prenatal Alcohol Use and FASD: Diagnosis, Assessment and New Directions in Research and Multimodal Treatment* (Aubato S, Cohen D eds), pp 3–29. Bentham Science Publishers Ltd, Sharjah, United Arab Emirates.
- Australian Institute of Family Studies (2015) The Longitudinal Study of Australian Children Annual Statistical Report 2014. AIFS, Melbourne.
- Bergen-Cico D, Kilmer J (2010) Reported changes in students' alcohol consumption following a brief education of what constitutes a standard drink. *J Alcohol Drug Educ* 54:72–84.
- Bower C, Elliot E (2016) Report to the Australian Government of Health: Australian Guide to the Diagnosis of Fetal Alcohol Spectrum Disorder (FASD). Australian Government, Canberra.
- Bower C, Watkins RE, Mutch RC, Marriott R, Freeman J, Kippin NR, Safe B, Pestell C, Cheung CSC, Shield H, Tarratt L, Springall A, Taylor J, Walker N, Argiro E, Leitão S, Hamilton S, Condon C, Passmore HM, Giglia R (2018) Fetal alcohol spectrum disorder and youth justice: a prevalence study among young people sentenced to detention in Western Australia. *BMJ Open* 8:e019605.
- Bush K, Kivlahan DR, McDonnell MB, Fihn SD, Bradley KA (1998) The AUDIT Alcohol Consumption Questions (AUDIT-C): an effective brief screening test for problem drinking. *Arch Intern Med* 158:1789–1795.
- Callinan S, Ferris J (2014) Trends in alcohol consumption during pregnancy in Australia, 2001–2010. *Int J Alcohol Drug Res* 3:17–24.
- Carr MB, Vandiver TA (2001) Risk and protective factors among youth offenders. *Adolescence* 36:409–426.
- Chasnoff IJ, Wells AM, King L (2015) Misdiagnosis and missed diagnoses in foster and adopted children with prenatal alcohol exposure. *Pediatrics* 135:264–270.

- Chiodo LM, Sokol RJ, Delaney-Black V, Janisse J, Hannigan JH (2010) Validity of the T-ACE in pregnancy in predicting child outcome and risk drinking. *Alcohol* 44:595–603.
- Corrigan PW, Lara JL, Shah BB, Mitchell KT, Simmes D, Jones KL (2017) The public stigma of birth mothers of children with fetal alcohol spectrum disorders. *Alcohol Clin Exp Res* 41:1166–1173.
- Dawson DA, Grant BF, Stinson FS, Zhou Y (2005) Effectiveness of the Derived Alcohol Use Disorders Identification Test (AUDIT-C) in screening for alcohol use disorders and risk drinking in the US general population. *Alcohol Clin Exp Res* 29:844–854.
- Eichler A, Grunitz J, Grimm J, Walz L, Raabe E, Goecke TW, Beckmann MW, Kratz O, Heinrich H, Moll GH, Fasching PA, Kornhuber J (2016) Did you drink alcohol during pregnancy? Inaccuracy and discontinuity of women's self-reports: on the way to establish meconium ethyl glucuronide (EtG) as a biomarker for alcohol consumption during pregnancy. *Alcohol* 54:39–44.
- Ethen M, Ramadhani T, Scheuerle A, Canfield M, Wyszynski D, Druschel C, Romitti P; National Birth Defects Prevention Study (2009) Alcohol consumption by women before and during pregnancy. *Matern Child Health J* 13:274–285.
- Fast DK, Conry J, Loock C (1999) Identifying fetal alcohol syndrome among youth in the criminal justice system. *J Dev Behav Pediatr* 20:370–372.
- Feldman HS, Jones KL, Lindsay S, Slymen D, Klonoff-Cohen H, Kao K, Rao S, Chambers C (2012) Prenatal alcohol exposure patterns and alcohol-related birth defects and growth deficiencies: a prospective study. *Alcohol Clin Exp Res* 36:670–676.
- Fitzpatrick JP, Latimer J, Ferreira ML, Carter M, Oscar J, Martiniuk AL, Watkins RE, Elliott EJ (2015) Prevalence and patterns of alcohol use in pregnancy in remote Western Australian communities: the Lililwan Project. *Drug Alcohol Rev* 34:329–339.
- Hafekost K, Lawrence D, O'Leary C, Bower C, Semmens J, Zubrick SR (2017) Maternal alcohol use disorder and risk of child contact with the justice system in Western Australia: a population cohort record linkage study. *Alcohol Clin Exp Res* 41:1452–1460.
- Halliday JL, Muggli E, Lewis S, Elliott EJ, Amor DJ, O'Leary C, Donath S, Forster D, Nagle C, Craig JM, Anderson PJ (2017) Alcohol consumption in a general antenatal population and child neurodevelopment at 2 years. *J Epidemiol Community Health* 71:990–998.
- Hannigan JH, Chiodo LM, Sokol RJ, Janisse J, Ager JW, Greenwald MK, Delaney-Black V (2010) A 14-year retrospective maternal report of alcohol consumption in pregnancy predicts pregnancy and teen outcomes. *Alcohol* 44:583–594.
- Kowalyszyn M, Kelly AB (2003) Family functioning, alcohol expectancies and alcohol-related problems in a remote Aboriginal Australian community: a preliminary psychometric validation study. *Drug Alcohol Rev* 22:53–59.
- Lange S, Shield K, Koren G, Rehm J, Popova S (2014) A comparison of the prevalence of prenatal alcohol exposure obtained via maternal self-reports versus meconium testing: a systematic literature review and meta-analysis. *BMC Pregn Childbirth* 14:127. Available at: <https://doi.org/10.1186/1471-2393-14-127>. Accessed November 29, 2018.
- Lee KSK, Wilson S, Perry J, Room R, Callinan S, Assan R, Hayman N, Chikritzhis T, Gray D, Wilkes E, GradDipIndigH PJ, Conigrave KM (2018) Developing a tablet computer-based application ('App') to measure self-reported alcohol consumption in Indigenous Australians. *BMC Med Inform Decis Mak* 18:8. Available at: <https://doi.org/10.1186/s12911-018-0583-0>. Accessed November 29, 2018.
- Lopez MB, Lichtenberger A, Conde K, Cremonte M (2017) Psychometric properties of brief screening tests for alcohol use disorders during pregnancy in Argentina. *Revista Brasileira Ginecologia e Obstetricia* 39:322–329.
- Mallard SR, Connor JL, Houghton LA (2013) Maternal factors associated with heavy periconceptional alcohol intake and drinking following pregnancy recognition: a post-partum survey of New Zealand women. *Drug Alcohol Rev* 32:389–397.
- McCormack C, Hutchinson D, Burns L, Wilson J, Elliott E, Allsop S, Najman J, Jacobs S, Rossen L, Olsson C, Mattick R (2017) Prenatal alcohol consumption between conception and recognition of pregnancy. *Alcohol Clin Exp Res* 41:369–378.
- McHugh KR, Sugarman DE, Kaufman JS, Park S, Weiss RD, Greenfield SF (2014) Readability of self-report alcohol misuse measures. *J Stud Alcohol Drugs* 75:328–334.
- McLachlan K (2017) Fetal Alcohol Spectrum Disorder in Yukon Corrections. Yukon Department of Justice, Canada.
- Muggli E, Cook B, O'Leary C, Forster D, Halliday J (2010) Alcohol in Pregnancy: What Questions Should We Be Asking? Report to the Commonwealth Department of Health and Ageing. Murdoch Children's Research Institute, Melbourne, Australia.
- Muggli E, Cook B, O'Leary C, Forster D, Halliday J (2015) Increasing accurate self-report in surveys of pregnancy alcohol use. *Midwifery* 31:e23–e28.
- Muggli E, O'Leary C, Donath S, Orsini F, Forster D, Anderson PJ, Lewis S, Nagle C, Craig JM, Elliott E, Halliday J (2016) "Did you ever drink more?" A detailed description of pregnant women's drinking patterns. *BMC Public Health* 16:1–13.
- Murdoch Children's Research Institute (2010) Alcohol in Pregnancy: What Questions Should We Be Asking? Technical report. Australian Commonwealth Department of Health and Aging. Murdoch Children's Research Institute, Victoria.
- Murphy A, Chittenden M (2005) Time OUT II: A Profile of BC Youth in Custody. The McCreary Centre Society, Vancouver.
- Passmore HM, Giglia R, Watkins RE, Mutch RC, Marriott R, Pestell C, Zubrick SR, Rainsford C, Walker N, Fitzpatrick JP, Freeman J, Kippin N, Safe B, Bower C (2016) Study protocol for screening and diagnosis of fetal alcohol spectrum disorders (FASD) among young people sentenced to detention in Western Australia. *BMJ Open* 6:e012184.
- Poole N (2008) Fetal Alcohol Spectrum Disorder (FASD) Prevention: Canadian Perspectives. Public Health Agency of Canada, Ottawa. Available at: <http://www.phac-aspc.gc.ca/hp-ps/dca-dea/prog-ini/fasd-etcaf/publications/cp-pc/index-eng.php>. Accessed March 13, 2011.
- Roger T, Ting Y (2007) Sensitive questions in surveys. *Psychol Bull* 155:859–883.
- Rojas E, Gretton HM (2007) Background, offence characteristics, and criminal outcomes of Aboriginal youth who sexually offend: a closer look at Aboriginal youth intervention needs. *Sex Abuse* 19:257–283.
- Russell M (1994) New assessment tools for risk drinking during pregnancy: T-ACE, TWEAK and others. *Alcohol Health Res World* 18:55–61.
- Schroder KE, Carery MP, Vanable PA (2003) Methodological challenges in research on sexual risk behavior: II. Accuracy of self-reports. *Ann Behav Med* 26:104–123.
- Smith A, Cox K, Poon C, Stewart D (2013) Time Out III: A Profile of BC Youth in Custody. The McCreary Centre Society, Vancouver.
- Smith L, Savory J, Couves J, Burns E (2014) Alcohol consumption during pregnancy: cross-sectional survey. *Midwifery* 30:1173–1178.
- Sokol RJ, Martier SS, Ager JW (1989) The T-ACE questions: practical prenatal detection of risk-drinking. *Am J Obstet Gynecol* 160:863–868.