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Role of Drinking Attitudes and Trait Impulsivity in Prenatal Alcohol Craving and Consumption in Mothers of Reproductive Age

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ABSTRACT

Background/Objective: Recognizing the severe consequences of alcohol consumption during pregnancy, such as fetal alcohol spectrum disorders (FASDs), the present study explored the role of drinking attitudes, trait impulsivity, and decision-making toward instant gratification in alcohol craving and consumption during pregnancy among mothers of reproductive age.

Methods: Utilizing participants from Amazon Mechanical Turk ($N=141$), we first categorized mothers into three groups: those who neither craved nor consumed alcohol during their last pregnancy, those who craved but did not consume, and those who craved and consumed alcohol. Using binomial logistic regression, we then examined what factors, if any, could differentiate between (a) mothers who craved alcohol during pregnancy and those who did not and (b) mothers who resisted alcohol cravings and those who yielded to them.

Results: The findings indicated that drinking attitudes significantly predicted alcohol craving during pregnancy. However, trait impulsivity emerged as a significant predictor of alcohol consumption among those who experienced cravings.

Conclusion: The present study contributes to a better understanding of psychological mechanisms underlying alcohol craving and consumption during pregnancy, which in turn may contribute to the development of targeted interventions for this problem.

KEYWORDS



Prenatal alcohol consumption; prenatal alcohol craving; trait impulsivity; drinking attitudes; mothers of reproductive age

Alcohol consumption during pregnancy is a critical public health concern, as it can lead to numerous adverse outcomes for both the mother and the developing child. The prevalence of alcohol consumption during pregnancy varies across countries, with 9.8% of pregnant women reporting current alcohol consumption in the United States (England et al., 2020). This behavior is associated with a range of negative consequences, including an increased risk of miscarriage, stillbirth, and preterm birth, as well as fetal alcohol spectrum disorders (FASDs) in the child (e.g., Gomez et al., 2022; May et al., 2018). Aside from FASDs, prenatal alcohol exposure has been linked to impaired cognitive function, attention deficits, and lower IQ in offspring (Goldschmidt et al., 1996; Streissguth et al., 1994). Additionally, children exposed to alcohol during pregnancy are more likely to experience growth restrictions, low birth weight, and facial abnormalities (Lennon et al., 2010). Maternal alcohol consumption during pregnancy has also been associated with higher rates of maternal depression, anxiety, and substance abuse (Burd et al., 2003). These negative consequences highlight the importance of public health interventions and support services for pregnant women who consume alcohol.


To prevent these adverse outcomes due to maternal alcohol consumption during pregnancy, identifying predictors for this

behavior is essential. Previous research has identified various demographic, psychological, and social factors that contribute to alcohol consumption during pregnancy, including age, race, education, and socioeconomic status (e.g., Lepper et al., 2016; Peardon et al., 2010; Shmulewitz & Hasin, 2019), as well as social support and partner alcohol use (Chang et al., 2006). Some clinical conditions, such as depression, experience of abuse, and tobacco smoking, have been identified as risk factors for alcohol consumption during pregnancy (Leonardson & Loudenburg, 2003; O’Keeffe et al., 2015; Shmulewitz & Hasin, 2019).

With respect to psychological factors, several personality traits, such as higher extraversion, openness, and novelty seeking, as well as lower conscientiousness and agreeableness, are associated with a propensity for alcohol consumption during pregnancy (Leszko et al., 2020; Lupattelli et al., 2021; Magnusson et al., 2007; Murakami, Ishikuro, et al., 2021). Drinking motives are also associated with this behavior: mothers with higher social drinking motives are more likely to consume alcohol during pregnancy (Skagerström et al., 2013). This aligns with findings related to the trait of extraversion (cf. Stewart & Devine, 2000) and support the observation that social acceptability and pressure to consume alcohol are among the most common reasons for alcohol consumption during pregnancy (Popova et al., 2022).

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In terms of cognitive variables, mothers' positive attitudes toward alcohol consumption during pregnancy also predict the behavior (e.g., Duncan et al., 2012; Fletcher et al., 2018; Fletcher et al., 2023), although it remains unclear whether the positive attitudes lead to the behavior of alcohol consumption during pregnancy or engaging in the behavior shapes the attitudes (Fletcher et al., 2018). Nevertheless, it is important to note that drinking attitudes may not be a reliable predictor for alcohol consumption during pregnancy. For example, previous research revealed that most pregnant women considered avoiding alcohol during pregnancy to be the safest option, although they still believed low-level drinking during pregnancy was acceptable (Gomez et al., 2022). More directly, another study found that more than half of the women who held negative attitudes toward alcohol consumption during pregnancy reported engaging in the behavior, illustrating an attitude-behavior gap (Fletcher et al., 2018). This discrepancy between attitudes and behavior may underscore the potential influence of some forms of impulsivity, and the present study explored this possibility (cf. Magnusson et al., 2007).

Impulsivity is a multi-asset construct, which often consists of trait impulsivity and behavioral impulsivity (e.g., Herman et al., 2018), and these two measures evaluate distinct psychological constructs or processes (e.g., Strickland & Johnson, 2021). Trait impulsivity is a stable, enduring characteristic of individuals that reflects a general tendency to engage in spontaneous, unplanned actions without considering potential consequences (Whiteside & Lynam, 2001). Behavioral impulsivity, on the other hand, is a specific behavioral/cognitive process that is often divided into at least two major dimensions: impulsive action (through response disinhibition or the inability to inhibit inappropriate or unwanted behaviors) and impulsive decision-making toward instant gratification (through subjective devaluation of future rewards; Weafer et al., 2013). Previous meta-analyses have well established that all of these impulsivity constructs are positively associated with problematic alcohol use (e.g., Coskunpinar et al., 2013; MacKillop et al., 2011; Smith et al., 2014).

However, relatively little is known about the role of individual differences in trait and behavioral impulsivity in predicting alcohol consumption during pregnancy. To identify a protective mechanism against alcohol consumption during pregnancy, the present study examined the role of trait impulsivity and impulsive decision-making toward instant gratification in alcohol craving and consumption during pregnancy. Moving beyond earlier research that primarily differentiated between pregnant alcohol consumers and abstainers only (e.g., Lupattelli et al., 2021), we focus on identifying factors that can differentiate between mothers who craved alcohol during pregnancy and mothers who did not, as well as between mothers who craved but resisted alcohol consumption and those who craved and consumed alcohol during pregnancy. This approach acknowledges that not all abstainers experience alcohol cravings during pregnancy, allowing for a deeper exploration into how individual differences in impulsivity influence the subsequent decision-making process that leads to either resisting or succumbing to these cravings.

In this study, we first identified three groups of mothers: (a) those who neither craved nor consumed alcohol during pregnancy, (b) those who craved alcohol but did not consume it, and (c) those who both craved and consumed alcohol. Our examination focused on whether attitudes toward drinking, trait impulsivity, and impulsive decision-making toward instant gratification could predict alcohol craving and consumption during pregnancy. Specifically, we sought to understand what factors, if any, could differentiate between (a) mothers who craved alcohol during pregnancy and those who did not and (b) mothers who resisted alcohol cravings and those who yielded to them. As this was an exploratory study, we did not formulate any *a priori* hypotheses. Nonetheless, by exploring these relationships, we aimed to inform the development of targeted intervention strategies to prevent alcohol consumption during pregnancy, especially for those most at risk due to impulsive tendencies.

Method

Participants and setting

Participants were recruited *via* Amazon Mechanical Turk in two steps. Initially, individuals completed a screen survey inquiring about their age, biological sex, and the age of their youngest biological child. Eligible participants—women aged 18 to 50 with a youngest biological child aged 0 to 2—were invited to partake in the main survey. A total of 141 participants consented to participate in this study and completed the survey hosted on Qualtrics (Provo, UT). Upon completion, they were provided with a code to claim \$2.50 compensation through Amazon Mechanical Turk.

Procedures and materials

On completing the informed consent process, participants filled out questionnaires that encompassed demographic information (including their alcohol experiences), trait impulsivity, and tendencies toward impulsive decision-making for instant gratification. This study is a segment of a broader survey examining various maternal health behaviors (e.g., breastfeeding). Portions of data have been reported in other studies, each with distinct goals and analyses (Hayashi et al., 2022, 2023). The Institutional Review Board at the first author's affiliated university deemed the study exempt (Study ID: 13294).

Demographics and alcohol-related measures

The participants were first asked their age, race/ethnicity, education, annual household income, and marital status. They then completed questionnaires on their general attitudes toward alcohol use and frequencies of alcohol craving and consumption during their most recent pregnancy (see Supplemental Online Material for all questions presented in this study). Attitudes toward alcohol use were assessed with four 7-point semantic differential items, adopted from the standard Theory of Planned Behavior questionnaire (Francis

et al., 2004), and means across items were used for the subsequent analyses. The Cronbach's alpha with the current sample was .947. The questions on frequencies on alcohol craving and consumption during pregnancy (e.g., "How often did you feel like having a drink containing alcohol during the most recent pregnancy?") were answered with four response options, but the responses were scored dichotomously (0: not at all, 1: at least once) because there is no known safe amount of alcohol use during pregnancy (Centers for Disease Control and Prevention [CDC], 2022).

Trait impulsivity and impulsive decision-making toward instant gratification

Trait impulsivity was assessed using the Barratt Impulsiveness Scale-Brief (BIS-Brief; Steinberg et al., 2013; hereafter BIS). The scale comprises eight items, each rated on a 4-point Likert scale: 1 (*rarely/never*), 2 (*Occasionally*), 3 (*Often*), and 4 (*almost always/always*). Negatively worded items are reverse-coded, and higher scores indicate elevated impulsivity. The Cronbach's alpha with the present sample was 0.781.

Impulsive decision-making toward instant gratification was measured using a hypothetical monetary choice delay-discounting task adapted from Jones and Rachlin (2009). The participants made repeated choices between smaller but sooner hypothetical monetary rewards versus larger but delayed hypothetical monetary rewards (1 week, 1 month, 6 months, 1 year, or 5 years). The smaller-sooner rewards ranged from \$99 to \$1 (\$99, \$90, \$80, \$70, \$60, \$50, \$40, \$30, \$20, \$10, and \$1, presented in this order), and the larger-delayed reward was always \$100 after a fixed delay. The degree of impulsive decision-making was quantified using the model-based area under the curve (AUC), calculated based on the methods described in Gilroy et al. (2017) and Gilroy and Hantula (2018). Lower AUC scores indicate higher levels of impulsive decision-making toward instant gratification. Consistent with previous studies (Smith et al., 2018), 18 participants were excluded from analyses due to non-systematic response patterns, based on the criteria described in Johnson and Bickel (2008).

Data analysis

Participants were classified into three subgroups according to their frequency of alcohol craving and consumption during the last pregnancy: (a) mothers who did not crave alcohol and did not consume any ($n=80$; hereafter *No-Craving-No-Consumption* [NC-NC] subgroup), (b) mothers who craved alcohol at least once but did not consume any ($n=37$; *Craving-No-Consumption* [C-NC] subgroup), and (c) mothers who craved alcohol at least once and actually consumed at least one alcoholic drink ($n=22$; *Craving-Consumption* [C-C] subgroup). There were two mothers who did not crave alcohol but consumed at least one alcoholic drink. While this subgroup was interesting, its small size precluded forming an independent group for analysis, and thus, data from these participants were not included in the subsequent analyses.

Categorical variables were analyzed with Fisher's exact test. Continuous variables were analyzed with a one-way analysis of variance (ANOVA), or the Brown-Forsythe

ANOVA if the assumption of homogeneity of variances was violated (assessed by Levene's test for equality of variances). To discern the predictive variables for group membership, binomial logistic regression analyses were conducted in two separate comparisons: (a) the NC-NC subgroup versus the C-NC and C-C subgroups combined (i.e., no alcohol craving vs. alcohol craving during pregnancy), and (b) the C-NC subgroup versus the C-C subgroup (no alcohol consumption vs. alcohol consumption among those who craved alcohol during pregnancy). Only variables with significant differences across groups were included in the regression analyses. All statistical analyses were executed using SPSS Version 29, GraphPad Prism Version 9, or R Version 4.30, with the threshold for statistical significance set at $p < 0.05$.

Results

Table 1 presents the demographic characteristics and frequencies of alcohol craving and consumption for the three subgroups. A comparison of the frequency of alcohol craving between the C-NC subgroup and the C-C subgroup revealed no statistically significant association, $p = 0.270$. Comparisons of other measures among the three subgroups revealed statistically significant associations between the subgroups and levels of education, $p = 0.006$, and between subgroups and amounts of annual income, $p = 0.001$. However, no significant associations were observed with the other variables ($p > 0.05$).

Figure 1 shows mean Drinking Attitudes, BIS, and AUC scores across subgroups. Statistically significant differences across three subgroups were observed on Drinking Attitudes, $F(2, 54.4) = 19.79$, $p < 0.001$, partial $\eta^2 = 0.21$, and on BIS, $F(2, 136) = 17.91$, $p < 0.001$, partial $\eta^2 = 0.07$. On the other hand, no statistically significant difference was observed on AUC, $F(2, 118) = 0.06$, $p = 0.945$, partial $\eta^2 = 0.00$. The results of the post-hoc comparisons on Drinking Attitudes and BIS are shown in Table 2. Notably, large effect sizes (Cohen's $D > 0.8$) were observed in Drinking Attitudes between the NC-NC and C-NC subgroups and between the NC-NC and C-C subgroups. Similarly, BIS scores showed large effect sizes between the C-NC and C-C subgroups.

Lastly, the results of the binomial logistic regression analyses are presented in Table 3. For alcohol craving during pregnancy (the NC-NC subgroup vs. the C-NC and C-C subgroups combined), the model was statistically significant, $\chi^2(4) = 34.54$, $p < 0.001$, explaining 29.2% of the variance. An increase in positive drinking attitudes significantly predicted the occurrence of alcohol craving ($p < 0.001$, odds ratio = 1.83). Regarding alcohol consumption during pregnancy (the C-NC subgroup vs. the C-C subgroup), the model was also statistically significant, $\chi^2(4) = 18.41$, $p < 0.001$, explaining 36.6% of the variance. Consumption was significantly predicted by receiving a bachelor's degree ($p = 0.024$, odds ratio = 16.43) and an increase in the BIS score ($p = 0.033$, odds ratio = 1.19).

Discussion

The present study compared three groups of mothers of reproductive age in terms of drinking attitudes, trait

Table 1. Demographic characteristics and drinking-related measures.

Variables	Categories	Subgroups			<i>p</i>
		NC-NC	C-NC	C-C	
<i>n</i>		80	37	22	–
Alcohol craving	Never	80 (100%)	–	–	.270 ^a
	Monthly or less	–	25 (68%)	11 (50%)	
	More than monthly	–	12 (32%)	11 (50%)	
Alcohol use	Never	80 (100%)	37 (100%)	–	–
	Monthly or less	–	–	13 (59%)	
	More than monthly	–	–	9 (41%)	
Age ^b		31.5 (5.7)	30.8 (4.9)	33.0 (7.4)	.401 ^c
Race/Ethnicity	White	56 (70%)	27 (73%)	13 (59%)	.509
	Non-white	24 (30%)	10 (27%)	9 (41%)	
Education	Associate or less	29 (36%)	14 (38%)	1 (4%)	.006
	Bachelor's or more	51 (64%)	23 (62%)	21 (96%)	
Annual income	< \$50,000	27 (34%)	4 (11%)	12 (55%)	.001
	≥ \$50,000	53 (66%)	33 (89%)	10 (45%)	
Marital status	Married	56 (70%)	27 (73%)	18 (82%)	.602
	Not married	24 (30%)	10 (27%)	4 (18%)	

Note. ^aBetween the C-NC and C-C subgroups only. ^bMeans and standard deviations. ^cBased on ANOVA, $F(2, 136) = 0.92$. NC-NC=No Craving-No Consumption subgroup. C-NC=Craving-No Consumption subgroup. C-C=Craving-Consumption subgroup. Bold numbers indicate statistical significance.

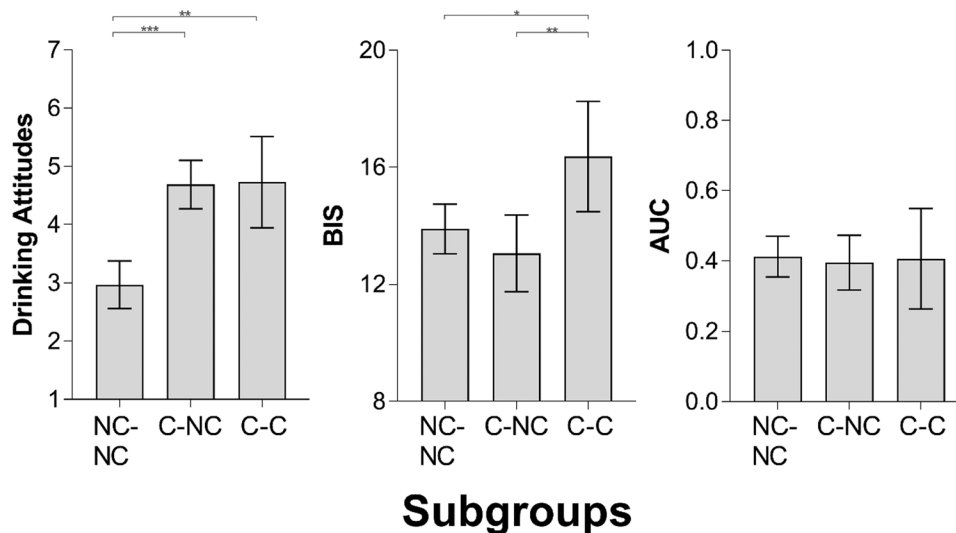


Figure 1. Mean drinking attitude, BIS, and AUC scores across subgroups. Note. Error bars indicate 95% confidence intervals. NC-NC=No Craving-No Consumption subgroup. C-NC=Craving-No Consumption subgroup. C-C=Craving-Consumption subgroup. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2. Post-hoc comparisons of drinking attitudes and BIS scores among subgroups.

Measures	Comparison	Δ	SE	<i>p</i>	95% CI	<i>D</i>
Attitudes	NC-NC vs. C-NC	-1.72	0.29	< .001	[-2.41, -1.03]	1.03
	NC-NC vs. C-C	-1.76	0.43	.001	[-2.81, -0.71]	0.97
	C-NC vs. C-C	-0.04	0.43	.995	[-1.09, 1.01]	0.03
BIS	NC-NC vs. C-NC	0.83	0.77	.530	[-1.00, 2.67]	0.22
	NC-NC vs. C-C	-2.48	0.94	.025	[-4.70, -0.25]	0.64
	C-NC vs. C-C	-3.31	1.05	.006	[-5.79, -0.82]	0.82

Note. Bold numbers indicate statistical significance. *p*value and 95% CI's were adjusted for multiple comparisons according to the Games-Howell or Tukey method. Δ = mean difference. NC-NC=No Craving-No Consumption subgroup. C-NC=Craving-No Consumption subgroup. C-C=Craving-Consumption subgroup.

impulsivity, and impulsive decision-making toward instant gratification: (a) mothers who neither craved nor consumed alcohol during pregnancy, (b) mothers who craved alcohol but did not consume it, and (c) mothers who both craved and consumed alcohol. The results show that drinking attitudes significantly differentiated between mothers who

craved alcohol during pregnancy and those who did not. The results also show that education level and trait impulsivity, but not impulsive decision-making, significantly differentiated between mothers who craved alcohol but did not consume it during pregnancy and those who craved and consumed alcohol.

The present study contributes to the literature by demonstrating that alcohol craving and consumption during pregnancy are associated with distinct risk factors, namely drinking attitudes, education level, and trait impulsivity. With respect to drinking attitudes, the present findings are consistent with previous studies utilizing the Theory of Planned Behavior, which demonstrated that positive drinking attitudes predict intention to drink during pregnancy (Duncan et al., 2012; Fletcher et al., 2023). The present findings also align with previous studies (e.g., Shmulewitz & Hasin, 2019; Tsang et al., 2022), indicating that women with higher education levels are at an increased risk of alcohol consumption during pregnancy. Notably, in our sample,

Table 3. Binominal logistic regression predicting alcohol craving and consumption during pregnancy.

	Alcohol craving (NC-NC vs. C-NC & C-C)						Alcohol consumption (C-NC vs. C-C)					
	<i>B</i>	SE	Wald	OR	[95% CI]	<i>p</i>	<i>B</i>	SE	Wald	OR	[95% CI]	<i>p</i>
Constant	-3.36	1.04	10.52	0.03	–	.001	-3.79	2.02	3.51	0.02	–	.061
Education	0.51	0.45	1.30	1.66	[0.69, 3.98]	.254	2.80	1.24	5.13	16.43	[1.46, 185.23]	.024
Income	0.53	0.58	0.84	1.70	[0.55, 5.28]	.360	-1.77	1.29	1.88	0.17	[0.01, 2.14]	.171
Attitude	0.60	0.12	23.93	1.83	[1.44, 2.33]	< .001	0.00	0.23	0.00	1.00	[0.63, 1.57]	.986
BIS	-0.01	0.05	0.03	0.99	[0.89, 1.10]	.855	0.17	0.08	4.56	1.19	[1.01, 1.39]	.033

Note. References for Education and Income were \leq Associate and $<$ \$50,000, respectively. Bold numbers indicate statistical significance. NC-NC=No Craving-No Consumption subgroup. C-NC=Craving-No Consumption subgroup. C-C=Craving-Consumption subgroup. OR=Odds Ratio. CI=confidence interval.

education level emerged as a particularly robust predictor. Nevertheless, a previous study showed that women with higher education are more likely to consume alcohol in early pregnancy but cease it between early and middle pregnancy, especially working women (Murakami, Obara, et al., 2021). This highlights the need for targeted interventions and educational programs that specifically address the risks of alcohol use during pregnancy among socioeconomically advantaged women (Ruyak et al., 2023).

Importantly, the present study uniquely contributes to the literature by identifying trait impulsivity as a risk factor that predicts alcohol consumption among mothers who experience alcohol cravings during pregnancy (cf. Ruyak et al., 2023). In this context, the independence between trait impulsivity and impulsive decision-making toward instant gratification, as evidenced by a non-significant correlation ($r(128) = -0.11$, $p=0.236$; see also Smith & Hantula, 2008; Strickland & Johnson, 2021), is crucial for understanding the psychological mechanisms underlying alcohol consumption during pregnancy. Unlike its presumed etiological role in other substance use disorders (Audrain-McGovern et al., 2009; Bickel et al., 2014; Loree et al., 2015), impulsive decision-making toward instant gratification may not be a critical variable for alcohol consumption during pregnancy. This may suggest that pregnant women are unlikely to excessively discount future positive outcomes associated with their children, potentially due to a combination of factors, such as knowledge gained through education (e.g., Kerwin et al., 2012; Washio et al., 2019). Instead, other forms of impulsiveness, such as response disinhibition (Weafer et al., 2015), could be potentially more influential. This aligns with Marsh et al. (2002), who found that women who are high on trait impulsivity show greater response disinhibition, but not greater impulsive decision-making toward instant gratification. Understanding these distinctions should be vital for developing process-based intervention strategies (cf. Hofmann & Hayes, 2019) that can be tailored to those who are more vulnerable to the problem of alcohol consumption during pregnancy.

Implications for interventions

Aligning with previous studies demonstrating that women with heavier alcohol use exhibit greater response disinhibition than those with lighter use (Reed et al., 2012; Smith & Mattick, 2013), the present findings that trait impulsivity plays a key role in alcohol consumption during pregnancy direct attention to response (dis)inhibition as a potential intervention target. Notably, a meta-analysis by Allom et al. (2016) indicates that response inhibition training, such as the go/no-go task,

effectively improves health-related behaviors including alcohol consumption. This is exemplified by Houben et al. (2011), in which college students who were trained to respond to neutral stimuli while withholding their responses to alcohol-related target stimuli reduced actual alcohol consumption. Such response inhibition training might similarly benefit mothers who experience alcohol cravings during pregnancy.

However, the meta-analysis by Allom et al. (2016) also indicates that the effects of response inhibition training may not endure over time. In addition, more recent studies have failed to replicate earlier findings or provide evidence that the training enhances the effectiveness of treatment as usual when incorporated (e.g., Di Lemma & Field, 2017; Jones et al., 2020; Schenkel et al., 2023). Together, these findings highlight the need to explore supplemental or alternative strategies to achieve desirable outcomes. In this vein, it is important to note that women tend to use alcohol to cope with negative emotions more often than men (Hussong, 2007; Timko et al., 2005), and female high-risk alcohol users feel less capable of resisting alcohol when faced with negative emotions (Ricciardelli et al., 2001). Therefore, for mothers inclined to consume alcohol during pregnancy as a coping mechanism (Fleming et al., 2023), interventions focusing on emotional management, such as mindfulness-based approaches (Goldberg et al., 2018; Li et al., 2017), could be promising. A randomized-controlled trial conducted by MacKinnon et al. (2021) revealed that a mindfulness-based intervention was effective in reducing psychological distress in pregnant women seeking treatment for their psychological distress. An additional strategy that could supplement response inhibition training is a contingency management program, a therapeutic method providing incentives contingent on the demonstration of desired behavioral changes (Higgins et al., 2008). This approach has proven effective in treating various maternal health behaviors (see Washio et al., 2021, for review). Moreover, because contingency management uses relatively frequent positive reinforcement, it may be a particularly effective intervention for women higher in trait impulsivity. However, its specific application to reduce alcohol consumption during pregnancy remains under-researched (cf. Washio et al., 2017). Therefore, future studies should focus on this area, addressing the shortcomings of existing research to develop effective interventions.

Limitations

The present study has several limitations that warrant discussion. First, the present sample exclusively comprised

Amazon Mechanical Turk workers who were mothers of reproductive age and had given birth within the past 3 years. Additionally, the sample size was small. Given the exploratory nature of the present study, we did not conduct a priori power analysis due to the difficulty of estimating effect sizes. Therefore, non-significant results should be evaluated with caution, although the effect sizes observed were mostly large (Cohen's $D > 0.8$). Nevertheless, future studies should aim for larger and more diverse samples to assess the generalizability of the present findings.

Second, the assessment of alcohol craving and consumption during pregnancy relied on single-item, self-reported measures. This might have introduced some biases, including underreporting socially inappropriate behavior (Wentland, 1993) or inaccuracies due to memory lapses (Spinella, 2005). To mitigate these biases, future research would benefit from integrating these self-reported measures with objective data, such as biochemically verified indicators of alcohol consumption (Dozet et al., 2023). However, it is important to note that using such biochemical measures introduces potential issues related to confidentiality and participant privacy, necessitating careful ethical consideration and data handling to ensure participant adherence to research standards.

Finally, the present study, serving as an exploratory initial investigation with the small sample, did not allow for detailed analyses regarding the intensity of alcohol craving and the precise quantity and timing of alcohol consumption during pregnancy. Future research is needed to better understand these dynamics because the degree of craving might significantly influence the likelihood of alcohol consumption, and the amount and timing of consumption can vary greatly among individuals, potentially leading to different health outcomes. Understanding these nuances could aid in developing more tailored and effective intervention strategies.

Conclusion

The current study revealed that while drinking attitudes can predict alcohol craving during pregnancy, they are not effective predictors of actual consumption. This underscores the need for interventions that go beyond educational approaches that improve mothers' attitudes toward alcohol use (Fletcher et al., 2018). A notable finding of the present study is that trait impulsivity successfully predicted alcohol consumption among mothers with cravings, highlighting the importance of tailoring prevention strategies to this group. Future research should build on these insights, perhaps through longitudinal studies, to explore if low trait impulsivity is a protective factor against alcohol consumption in mothers with cravings. Such research could lead to more personalized treatments for high-risk alcohol use in pregnant women (Litten et al., 2015), deepening our understanding of the etiological factors involved in risky alcohol use during pregnancy.

Informed consent

Informed consent was obtained from all individual participants included in the study.


Declaration of interest

The authors declare that they have no conflict of interest.

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Data availability statement

The datasets used and analyzed during the current study are available from the corresponding author on request.

References

- Allom, V., Mullan, B., & Hagger, M. (2016). Does inhibitory control training improve health behaviour? A meta-analysis. *Health Psychology Review*, 10(2), 168–186. <https://doi.org/10.1080/17437199.2015.1051078>
- Audrain-McGovern, J., Rodriguez, D., Epstein, L. H., Cuevas, J., Rodgers, K., & Wileyto, E. P. (2009). Does delay discounting play an etiological role in smoking or is it a consequence of smoking? *Drug and Alcohol Dependence*, 103(3), 99–106. <https://doi.org/10.1016/j.drugalcdep.2008.12.019>
- Bickel, W. K., Johnson, M. W., Koffarnus, M. N., MacKillop, J., & Murphy, J. G. (2014). The behavioral economics of substance use disorders: Reinforcement pathologies and their repair. *Annual Review of Clinical Psychology*, 10(1), 641–677. <https://doi.org/10.1146/annurev-clinpsy-032813-153724>
- Burd, L., Klug, M. G., Martsolf, J. T., & Kerbeshian, J. (2003). Fetal alcohol syndrome: Neuropsychiatric phenomics. *Neurotoxicology and Teratology*, 25(6), 697–705. <https://doi.org/10.1016/j.ntt.2003.07.014>
- Centers for Disease Control and Prevention. (2022). *Alcohol use during pregnancy*. <https://www.cdc.gov/ncbddd/fasd/alcohol-use.html>
- Chang, G., McNamara, T. K., Orav, E. J., & Wilkins-Haug, L. (2006). Alcohol use by pregnant women: Partners, knowledge, and other predictors. *Journal of Studies on Alcohol*, 67(2), 245–251. <https://doi.org/10.15288/jsa.2006.67.245>
- Coskunpinar, A., Dir, A. L., & Cyders, M. A. (2013). Multidimensionality in impulsivity and alcohol use: A meta-analysis using the UPPS model of impulsivity. *Alcoholism, Clinical and Experimental Research*, 37(9), 1441–1450. <https://doi.org/10.1111/acer.12131>
- Di Lemma, L. C. G., & Field, M. (2017). Cue avoidance training and inhibitory control training for the reduction of alcohol consumption: A comparison of effectiveness and investigation of their mechanisms of action. *Psychopharmacology*, 234(16), 2489–2498. <https://doi.org/10.1007/s00213-017-4639-0>
- Dozet, D., Burd, L., & Popova, S. (2023). Screening for alcohol use in pregnancy: A review of current practices and perspectives. *International Journal of Mental Health and Addiction*, 21(2), 1220–1239. <https://doi.org/10.1007/s11469-021-00655-3>
- Duncan, E. M., Forbes-Mckay, K. E., & Henderson, S. E. (2012). Alcohol use during pregnancy: An application of the theory of planned behavior. *Journal of Applied Social Psychology*, 42(8), 1887–1903. <https://doi.org/10.1111/j.1559-1816.2012.00923.x>
- England, L. J., Bennett, C., Denny, C. H., Honein, M. A., Gilboa, S. M., Kim, S. Y., Guy, G. P., Tran, E. L., Rose, C. E., Bohm, M. K., &

- Boyle, C. A. (2020). Alcohol use and co-use of other substances among pregnant females aged 12–44 years—United States, 2015–2018. *MMWR. Morbidity and Mortality Weekly Report*, 69(31), 1009–1014. <https://doi.org/10.15585/mmwr.mm6931a1>
- Fleming, K. M., Gomez, K. U., Goodwin, L., & Rose, A. K. (2023). Identifying the motives for and against drinking during pregnancy and motherhood, and factors associated with increased maternal alcohol use. *Journal of Public Health*. Advance online publication. <https://doi.org/10.1007/s10389-023-02141-7>
- Fletcher, O. V., May, P. A., Seedat, S., Sikkema, K. J., & Watt, M. H. (2018). Attitudes toward alcohol use during pregnancy among women recruited from alcohol-serving venues in Cape Town, South Africa: A mixed-methods study. *Social Science & Medicine*, 215, 98–106. <https://doi.org/10.1016/j.socscimed.2018.09.008>
- Fletcher, T. M. D., Mullan, B., & Finlay-Jones, A. (2023). Intention to engage in alcohol use during pregnancy: The role of attitudes and prototypes. *Substance Use & Misuse*, 58(11), 1333–1342. <https://doi.org/10.1080/10826084.2023.2215292>
- Francis, J., Eccles, M. P., Johnston, M., Walker, A. E., Grimshaw, J. M., Foy, R., Kaner, E. F. S., Smith, L., & Bonetti, D. (2004). *Constructing questionnaires based on the theory of planned behaviour: A manual for health services researchers*. Centre for Health Services Research, University of Newcastle upon Tyne. <https://openaccess.city.ac.uk/id/eprint/1735/>
- Gilroy, S. P., Franck, C. T., & Hantula, D. A. (2017). The discounting model selector: Statistical software for delay discounting applications. *Journal of the Experimental Analysis of Behavior*, 107(3), 388–401. <https://doi.org/10.1002/jeab.257>
- Gilroy, S. P., & Hantula, D. A. (2018). Discounting model selection with area-based measures: A case for numerical integration. *Journal of the Experimental Analysis of Behavior*, 109(2), 433–449. <https://doi.org/10.1002/jeab.318>
- Goldberg, S. B., Tucker, R. P., Greene, P. A., Davidson, R. J., Wampold, B. E., Kearney, D. J., & Simpson, T. L. (2018). Mindfulness-based interventions for psychiatric disorders: A systematic review and meta-analysis. *Clinical Psychology Review*, 59, 52–60. <https://doi.org/10.1016/j.cpr.2017.10.011>
- Goldschmidt, L., Richardson, G. A., Stoffer, D. S., Geva, D., & Day, N. L. (1996). Prenatal alcohol exposure and academic achievement at age six: A nonlinear fit. *Alcoholism, Clinical and Experimental Research*, 20(4), 763–770. <https://doi.org/10.1111/j.1530-0277.1996.tb01684.x>
- Gomez, K. U., Goodwin, L., Chisholm, A., & Rose, A. K. (2022). Alcohol use during pregnancy and motherhood: Attitudes and experiences of pregnant women, mothers, and healthcare professionals. *PLoS One*, 17(12), e0275609. <https://doi.org/10.1371/journal.pone.0275609>
- Hayashi, Y., Fisher, N. M., Hantula, D. A., Furman, L., & Washio, Y. (2022). A behavioral economic demand analysis of mothers' decision to exclusively breastfeed in the workplace. *Journal of the Experimental Analysis of Behavior*, 118(1), 132–147. <https://doi.org/10.1002/jeab.772>
- Hayashi, Y., Hantula, D. A., & Washio, Y. (2023). A cluster analysis of mothers of reproductive age based on their attitude and risk of alcohol use. *Experimental and Clinical Psychopharmacology*, 31(2), 397–403. <https://doi.org/10.1037/pha0000567>
- Herman, A. M., Critchley, H. D., & Duka, T. (2018). The role of emotions and physiological arousal in modulating impulsive behaviour. *Biological Psychology*, 133, 30–43. <https://doi.org/10.1016/j.biopsycho.2018.01.014>
- Higgins, S. T., Silverman, K., & Heil, S. H. (Eds.). (2008). *Contingency management in substance abuse treatment*. Guilford Press.
- Hofmann, S. G., & Hayes, S. C. (2019). The future of intervention science: Process-based therapy. *Clinical Psychological Science*, 7(1), 37–50. <https://doi.org/10.1177/2167702618772296>
- Houben, K., Nederkoorn, C., Wiers, R. W., & Jansen, A. (2011). Resisting temptation: Decreasing alcohol-related affect and drinking behavior by training response inhibition. *Drug and Alcohol Dependence*, 116(1–3), 132–136. <https://doi.org/10.1016/j.drugalcdep.2010.12.011>
- Hussong, A. M. (2007). Predictors of drinking immediacy following daily sadness: An application of survival analysis to experience sampling data. *Addictive Behaviors*, 32(5), 1054–1065. <https://doi.org/10.1016/j.addbeh.2006.07.011>
- Johnson, M. W., & Bickel, W. K. (2008). An algorithm for identifying nonsystematic delay-discounting data. *Experimental and Clinical Psychopharmacology*, 16(3), 264–274. <https://doi.org/10.1037/1064-1297.16.3.264>
- Jones, A., Baines, L., Ruddock, H., Franken, I., Verbruggen, F., & Field, M. (2020). Does alcohol cue inhibitory control training survive a context shift? *Psychology of Addictive Behaviors*, 34(7), 783–792. <https://doi.org/10.1037/adb0000580>
- Jones, B. A., & Rachlin, H. (2009). Delay, probability, and social discounting in a public goods game. *Journal of the Experimental Analysis of Behavior*, 91(1), 61–73. <https://doi.org/10.1901/jeab.2009.91.61>
- Kerwin, M. E., Farris, M. D., & Hantula, D. A. (2012). Consumer choices of women in residential drug treatment: An analysis of risk and impulsivity. *Journal of Applied Social Psychology*, 42(4), 834–849. <https://doi.org/10.1111/j.1559-1816.2011.00830.x>
- Lennon, R., Rentfro, R., & O'Leary, B. (2010). Social marketing and distracted driving behaviors among young adults: The effectiveness of fear appeals. *Academy of Marketing Studies Journal*, 14, 95–113.
- Leonardson, G. R., & Loudenburg, R. (2003). Risk factors for alcohol use during pregnancy in a multistate area. *Neurotoxicology and Teratology*, 25(6), 651–658. <https://doi.org/10.1016/j.ntt.2003.07.002>
- Lepper, L. E. T., Lluca, A., Mayer, A., Patel, N., Salas, J., Xaverius, P. K., & Kramer, B. (2016). Socioeconomic status, alcohol use, and pregnancy intention in a national sample of women. *Prevention Science: The Official Journal of the Society for Prevention Research*, 17(1), 24–31. <https://doi.org/10.1007/s1121-015-0578-3>
- Leszko, M., Keenan-Devlin, L., Adam, E. K., Buss, C., Grobman, W., Simhan, H., Wadhwa, P., Mroczek, D. K., & Borders, A. (2020). Are personality traits associated with smoking and alcohol use prior to and during pregnancy? *PLoS One*, 15(5), e0232668. <https://doi.org/10.1371/journal.pone.0232668>
- Li, W., Howard, M. O., Garland, E. L., McGovern, P., & Lazar, M. (2017). Mindfulness treatment for substance misuse: A systematic review and meta-analysis. *Journal of Substance Abuse Treatment*, 75, 62–96. <https://doi.org/10.1016/j.jsat.2017.01.008>
- Litten, R. Z., Ryan, M. L., Falk, D. E., Reilly, M., Fertig, J. B., & Koob, G. F. (2015). Heterogeneity of alcohol use disorder: Understanding mechanisms to advance personalized treatment. *Alcoholism: Clinical and Experimental Research*, 39(4), 579–584. <https://doi.org/10.1111/acer.12669>
- Loree, A. M., Lundahl, L. H., & Ledgerwood, D. M. (2015). Impulsivity as a predictor of treatment outcome in substance use disorders: Review and synthesis. *Drug and Alcohol Review*, 34(2), 119–134. <https://doi.org/10.1111/dar.12132>
- Lupattelli, A., Ronningen, E., Krogsrud, S. K., Nordeng, H., & Ystrom, E. (2021). Personality and its relation to the use of Alcohol and cigarettes during pregnancy: A multinational study. *Journal of Health Psychology*, 26(9), 1293–1306. <https://doi.org/10.1177/1359105318775194>
- MacKillop, J., Amlung, M. T., Few, L. R., Ray, L. A., Sweet, L. H., & Munafò, M. R. (2011). Delayed reward discounting and addictive behavior: A meta-analysis. *Psychopharmacology*, 216(3), 305–321. <https://doi.org/10.1007/s00213-011-2229-0>
- MacKinnon, A. L., Madsen, J. W., Giesbrecht, G. F., Campbell, T., Carlson, L. E., Dimidjian, S., Letourneau, N., Tough, S., & Tomfohr-Madsen, L. (2021). Effects of mindfulness-based cognitive therapy in pregnancy on psychological distress and gestational age: Outcomes of a randomized controlled trial. *Mindfulness*, 12(5), 1173–1184. <https://doi.org/10.1007/s12671-020-01585-2>
- Magnusson, Å., Göransson, M., & Heilig, M. (2007). Hazardous alcohol users during pregnancy: Psychiatric health and personality traits. *Drug and Alcohol Dependence*, 89(2–3), 275–281. <https://doi.org/10.1016/j.drugalcdep.2007.01.015>
- Marsh, D. M., Dougherty, D. M., Mathias, C. W., Moeller, F. G., & Hicks, L. R. (2002). Comparisons of women with high and low trait impulsivity using behavioral models of response-disinhibition and

- reward-choice. *Personality and Individual Differences*, 33(8), 1291–1310. [https://doi.org/10.1016/S0191-8869\(02\)00014-4](https://doi.org/10.1016/S0191-8869(02)00014-4)
- May, P. A., Chambers, C. D., Kalberg, W. O., Zellner, J., Feldman, H., Buckley, D., Kopald, D., Hasken, J. M., Xu, R., Honerkamp-Smith, G., Taras, H., Manning, M. A., Robinson, L. K., Adam, M. P., Abdul-Rahman, O., Vaux, K., Jewett, T., Elliott, A. J., Kable, J. A., ... Hoyme, H. E. (2018). Prevalence of fetal alcohol spectrum disorders in 4US communities. *JAMA*, 319(5), 474–482. <https://doi.org/10.1001/jama.2017.21896>
- Murakami, K., Ishikuro, M., Ueno, F., Noda, A., Onuma, T., Matsuzaki, E., Metoki, H., Obara, T., & Kuriyama, S. (2021). Maternal personality and alcohol use during pregnancy in Japan: The Tohoku Medical Megabank Project Birth and Three-Generation Cohort Study. *Addictive Behaviors*, 122, 107020. <https://doi.org/10.1016/j.add-beh.2021.107020>
- Murakami, K., Obara, T., Ishikuro, M., Ueno, F., Noda, A., & Kuriyama, S. (2021). Associations of education and work status with alcohol use and cessation among pregnant women in Japan: The Tohoku Medical Megabank Project Birth and Three-Generation Cohort Study. *BMC Public Health*, 21(1), 1400. <https://doi.org/10.1186/s12889-021-11461-w>
- O’Keeffe, L. M., Kearney, P. M., McCarthy, F. P., Khashan, A. S., Greene, R. A., North, R. A., Poston, L., McCowan, L. M. E., Baker, P. N., Dekker, G. A., Walker, J. J., Taylor, R., & Kenny, L. C. (2015). Prevalence and predictors of alcohol use during pregnancy: Findings from international multicentre cohort studies. *BMJ Open*, 5(7), e006323. <https://doi.org/10.1136/bmjopen-2014-006323>
- Peardon, E., Payne, J., Henley, N., D’Antoine, H., Bartu, A., O’Leary, C., Bower, C., & Elliott, E. J. (2010). Women’s knowledge and attitudes regarding alcohol consumption in pregnancy: A national survey. *BMC Public Health*, 10(1), 510. <https://doi.org/10.1186/1471-2458-10-510>
- Popova, S., Dozet, D., Akhand Laboni, S., Brower, K., & Temple, V. (2022). Why do women consume alcohol during pregnancy or while breastfeeding? *Drug and Alcohol Review*, 41(4), 759–777. <https://doi.org/10.1111/dar.13425>
- Reed, S. C., Levin, F. R., & Evans, S. M. (2012). Alcohol increases impulsivity and abuse liability in heavy drinking women. *Experimental and Clinical Psychopharmacology*, 20(6), 454–465. <https://doi.org/10.1037/a0029087>
- Ricciardelli, L. A., Connor, J. P., Williams, R. J., & Young, R. M. (2001). Gender stereotypes and drinking cognitions as indicators of moderate and high risk drinking among young women and men. *Drug and Alcohol Dependence*, 61(2), 129–136. [https://doi.org/10.1016/S0376-8716\(00\)00131-9](https://doi.org/10.1016/S0376-8716(00)00131-9)
- Ruyak, S. L., Roberts, M. H., Chambers, S., Ma, X., DiDomenico, J., De La Garza, R., & Bakhireva, L. N. (2023). Impulsivity and alcohol use during pregnancy and postpartum: Insights from novel methodological approaches within the context of the COVID-19 pandemic. *Behavioral Sciences*, 13(7), 600. <https://doi.org/10.3390/bs13070600>
- Schenkel, E. J., Schöneck, R., Wiers, R. W., Veling, H., Becker, E. S., Lindenmeyer, J., & Rinck, M. (2023). Does selective inhibition training reduce relapse rates when added to standard treatment of alcohol use disorder? A randomized controlled trial. *Alcohol, Clinical & Experimental Research*, 47(5), 963–974. <https://doi.org/10.1111/acer.15055>
- Shmulewitz, D., & Hasin, D. S. (2019). Risk factors for alcohol use among pregnant women, ages 15–44, in the United States, 2002 to 2017. *Preventive Medicine*, 124, 75–83. <https://doi.org/10.1016/j.ypmed.2019.04.027>
- Skagerström, J., Alehagen, S., Häggström-Nordin, E., Årestedt, K., & Nilsen, P. (2013). Prevalence of alcohol use before and during pregnancy and predictors of drinking during pregnancy: A cross sectional study in Sweden. *BMC Public Health*, 13(1), 780. <https://doi.org/10.1186/1471-2458-13-780>
- Smith, C. L., & Hantula, D. A. (2008). Methodological considerations in the study of delay discounting in intertemporal choice: A comparison of tasks and modes. *Behavior Research Methods*, 40(4), 940–953. <https://doi.org/10.3758/BRM.40.4.940>
- Smith, J. L., & Mattick, R. P. (2013). Evidence of deficits in behavioural inhibition and performance monitoring in young female heavy drinkers. *Drug and Alcohol Dependence*, 133(2), 398–404. <https://doi.org/10.1016/j.drugalcdep.2013.06.020>
- Smith, J. L., Mattick, R. P., Jamadar, S. D., & Iredale, J. M. (2014). Deficits in behavioural inhibition in substance abuse and addiction: A meta-analysis. *Drug and Alcohol Dependence*, 145, 1–33. <https://doi.org/10.1016/j.drugalcdep.2014.08.009>
- Smith, K. R., Lawyer, S. R., & Swift, J. K. (2018). A meta-analysis of nonsystematic responding in delay and probability reward discounting. *Experimental and Clinical Psychopharmacology*, 26(1), 94–107. <https://doi.org/10.1037/pha0000167>
- Spinella, M. (2005). Self-rated executive function: Development of the executive function index. *The International Journal of Neuroscience*, 115(5), 649–667. <https://doi.org/10.1080/00207450590524304>
- Steinberg, L., Sharp, C., Stanford, M. S., & Tharp, A. T. (2013). New tricks for an old measure: The development of the Barratt Impulsiveness Scale–Brief (BIS–Brief). *Psychological Assessment*, 25(1), 216–226. <https://doi.org/10.1037/a0030550>
- Stewart, S. H., & Devine, H. (2000). Relations between personality and drinking motives in young adults. *Personality and Individual Differences*, 29(3), 495–511. [https://doi.org/10.1016/S0191-8869\(99\)00210-X](https://doi.org/10.1016/S0191-8869(99)00210-X)
- Streissguth, A. P., Barr, H. M., Sampson, P. D., & Bookstein, F. L. (1994). Prenatal alcohol and offspring development: The first fourteen years. *Drug and Alcohol Dependence*, 36(2), 89–99. [https://doi.org/10.1016/0376-8716\(94\)90090-6](https://doi.org/10.1016/0376-8716(94)90090-6)
- Strickland, J. C., & Johnson, M. W. (2021). Rejecting impulsivity as a psychological construct: A theoretical, empirical, and sociocultural argument. *Psychological Review*, 128(2), 336–361. <https://doi.org/10.1037/rev0000263>
- Timko, C., Finney, J. W., & Moos, R. H. (2005). The 8-year course of alcohol abuse: Gender differences in social context and coping. *Alcoholism, Clinical and Experimental Research*, 29(4), 612–621. <https://doi.org/10.1097/01.ALC.0000158832.07705.22>
- Tsang, T. W., Kingsland, M., Doherty, E., Anderson, A. E., Tully, B., Crooks, K., Symonds, I., Tremain, D., Dunlop, A. J., Wiggers, J., & Elliott, E. J. (2022). Predictors of alcohol use during pregnancy in Australian women. *Drug and Alcohol Review*, 41(1), 171–181. <https://doi.org/10.1111/dar.13330>
- Washio, Y., Atreyapurapu, S., Hayashi, Y., Taylor, S., Chang, K., Ma, T., & Isaacs, K. (2021). Systematic review on use of health incentives in U.S. to change maternal health behavior. *Preventive Medicine*, 145, 106442. <https://doi.org/10.1016/j.ypmed.2021.106442>
- Washio, Y., Frederick, J., Archibald, A., Bertram, N., & Crowe, J. A. (2017). Community-initiated pilot program “My Baby’s Breath” to reduce prenatal alcohol use. *Delaware Medical Journal*, 89(2), 46–51.
- Washio, Y., Hayashi, Y., Okeke, D., Shah, O., & Nykiel, S. (2019). Knowledge improvement on fetal alcohol spectrum disorders among community members. *Journal of Alcohol and Drug Education*, 63(3), 21–29.
- Weafer, J., Baggott, M. J., & de Wit, H. (2013). Test-retest reliability of behavioral measures of impulsive choice, impulsive action, and inattention. *Experimental and Clinical Psychopharmacology*, 21(6), 475–481. <https://doi.org/10.1037/a0033659>
- Weafer, J., De Arcangelis, J., & de Wit, H. (2015). Sex differences in behavioral impulsivity in at-risk and non-risk drinkers. *Frontiers in Psychiatry*, 6(72). <https://doi.org/10.3389/fpsy.2015.00072>
- Wentland, E. J. (1993). *Survey responses: An evaluation of their validity*. Academic Press.
- Whiteside, S. P., & Lynam, D. R. (2001). The Five Factor Model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences*, 30(4), 669–689. [https://doi.org/10.1016/S0191-8869\(00\)00064-7](https://doi.org/10.1016/S0191-8869(00)00064-7)