Addictive Behaviors Reports 16 (2022) 100448

Contents lists available at ScienceDirect

Addictive Behaviors Reports

journal homepage: www.elsevier.com/locate/abrep

Does loneliness before the age of twelve indirectly affect impaired control over drinking, alcohol use, and problems through perceived stress?

S. Berberian, J.A. Patock-Peckham *, K. Guarino, T. Gupta, F. Sanabria, F. Infurna

Arizona State University, Department of Psychology, Tempe, AZ 85287-1104, USA

ARTICLE INFO

Keywords:
Lonely
Stress
Impaired control over alcohol
Alcohol use
Stress dampening

ABSTRACT

Background: Loneliness is the pain of feeling socially isolated from others (Russell et al., 1980). The Stress-Dampening Hypothesis (Marlatt, 1987; Sayette, 1993; Sher, 1987) posits that individuals drink to alleviate negative affect. To date, it has not been determined whether loneliness experienced as a child can indirectly influence at-risk patterns of alcohol use through the mediating mechanism of stress and impaired control. Impaired control over alcohol use (IC) is the difficulty adhering to one's own self-proscribed limits on drinking behaviors (Heather et al., 1993). Impaired control is an at-risk pattern of use that is particularly relevant to emerging adults. **Methods:** We examined the direct and indirect relationships between childhood loneliness, stress, IC, and alcohol-related problems with a structural equation model. In a college student sample, we utilized a (k = 20,000) bootstrap technique and a model indirect command in Mplus to examine potential mediational pathways. Cisgender sex was included as a covariate. **Results:** Loneliness was directly linked to stress as well as to alcohol-related problems. Higher levels of loneliness were indirectly linked to both more alcohol use and alcohol-related problems through more stress and in turn, more impaired control over drinking. **Conclusions:** The current study is consistent with the Stress Dampening Hypothesis (Marlatt, 1987; Sayette, 1993; Sher, 1987). Our findings suggest that therapeutic interventions combating loneliness in childhood may disrupt the stress-dampening pathway to dysregulated alcohol use in emerging adulthood.

"The need to belong is a fundamental motivator of human behavior" (Baumeister & Leary, 1995, p. 497; Maslow, 1943).

1. Introduction

Loneliness is a plague affecting one third of individuals among industrialized countries (Cacioppo & Cacioppo, 2018) and occurs when there is a discrepancy between an individuals' desired and achieved social contact (Peplau & Perlman, 1979). Loneliness is subjective rather than contingent on objective measures of social isolation (Courtin & Knapp, 2017). Even when social interaction is plentiful, such as the first semester of college, loneliness may still be experienced (Curtona, 1982). Cacioppo et al.'s (2006) Evolutionary Model of Loneliness suggests the averseness of perceived social isolation functions through social pain and reward to stimulate social reconnection. Therefore, when the need to belong is not satisfied, cognitive, behavioral, and neurophysiological distress occurs (Cacioppo et al., 2006). Eisenberg's (2003) neuroimaging findings indicate that social exclusion elicits a pattern of neural activation similar to physical pain. Moreover, social connectedness is a rewarding experience (Rilling et al., 2002).

Loneliness is normative during development (Ladd & Ettekal, 2013) and can be transient or enduring across all ages (Qualter et al., 2015). Children feel and understand loneliness as a concept distinct from social isolation, at ages as young as five years old (Asher & Paquette, 2003). Perceived social isolation in childhood predicts social skill deficits, sleep dysregulation, depression, suicidality, and substance use in emerging adulthood (Harris et al., 2013; Jones et al., 2011; Qualter et al., 2010; Schinka et al., 2013). In a 12-year longitudinal study, Qualter and colleagues (2013) found children with sustained loneliness over time (ages 5–17 years old) consumed alcohol more frequently and in greater quantity at age 17 compared to non-lonely children. Based upon the extant literature, we hypothesize that recalled childhood loneliness before the age of 12 will directly predict more alcohol-related problems among emerging adults (Russell et al., 1980).

* Corresponding author.
E-mail addresses: slberber@asu.edu (S. Berberian), Julie.Patock@asu.edu (J.A. Patock-Peckham), Kguarino@asu.edu (K. Guarino), Tgupta13@asu.edu (T. Gupta), Federico.Sanabria@asu.edu (F. Sanabria), Frank.Infurna@asu.edu (F. Infurna).

https://doi.org/10.1016/j.abrep.2022.100448
Received 27 April 2022; Received in revised form 21 June 2022; Accepted 10 July 2022
Available online 13 July 2022

1.1. Stress as an outcome

Cacioppo and colleagues (2000) measured salivary cortisol throughout the day, and found that chronic loneliness was associated with increased cortisol. As cortisol is a hormone highly associated with stress, and indicative of hypothalamic-pituitary adrenocortical (HPA) axis activity, its increased presence relative to state and trait loneliness demonstrates the complex association between loneliness and stress reactivity (Doane & Adam, 2010). Lonely participants, relative to non-lonely participants, show atypical physiological stress reactivity (Brown et al., 2018), higher blood pressure (Ong et al., 2012) and more pro-inflammatory biomarkers (Steptoe et al., 2004), as well as reduced heart rate (Cacioppo et al., 2002) and cardiac output (Hawkley et al., 2003) when enduring acute stress. Hawkley et al., (2006) found that loneliness was associated with more self-reported perceived stress. While the relationship between stress and cortisol excretion is strong (Goldman et al., 2005), recent literature has only recently begun to consider perceived stress as a mediator for loneliness and other health-related problems (Huang et al., 2019; McHugh & Lawlor 2013). Therefore, this study hypothesizes perceived stress in the last month as a potential mediator between childhood loneliness and alcohol-related problems in emerging adulthood.

1.2. Impaired control over alcohol (IC)

Impaired control over alcohol (IC) refers to the inability to limit or abstain from drinking when there is an intention to do so (Heather et al., 1993). According to Patock-Peckham et al. (2001), IC is a failure of appropriate self-regulation specific to the drinking context. Previous research has found that IC mediates the relation between childhood adversity (i.e. maltreatment and trauma) to alcohol use among emerging adults (Frohe et al., 2020; Patock-Peckham et al., 2020). Hussong and Chassin (1994) found that impulsivity mediates the relation between states of negative affect (i.e., depression) and alcohol use. Patock-Peckham & Morgan-Lopez (2006) characterized impaired control as impulsivity specific to the drinking context. Albeit, IC additionally implicates the facet of intention to limit or abstain from drinking, while impulsivity does not (Bickel & Marsch, 2001; Heather et al., 1993). Considering the strong associations between impulsivity and impaired control (Leeman et al., 2012; Patock-Peckham & colleagues 2006; 2011; Wardell et al., 2016), as well as between depression and loneliness (Heinrich & Gullone, 2006), this study sought to explore the more specific pathways between loneliness, stress, and multiple drinking outcomes (e.g. IC, alcohol use, and alcohol-related problems) all in one pathway.

The Stress Dampening Hypothesis (Marlatt, 1987; Sayette, 1993; Sher, 1987) suggests that alcohol is a substance often used to alleviate negative affect. Yet, evidence for stress-induced drinking in self-administration studies is inconsistent. Some ad libitum studies fail to find a link; these studies utilized negative mood induction and anticipated shock paradigm manipulations (Cyders et al., 2016; Higgins & Marlatt, 1973). Other studies using the Trier Social Stress Test (TSST) manipulation find a causal link (McGrath et al., 2016; Patock-Peckham et al., 2022; Thomas et al., 2011). The latter evidence is more consistent with studies regarding the impact of childhood trauma on stress reactions such as insomnia (Noudali et al., 2022) and PTSD (Patock-Peckham et al., 2020). Furthermore, coping motives for drinking are positively related to increased IC (Canning et al., 2020; Leeman et al., 2007). Impaired control is associated with increased alcohol use quantity and frequency in college students (Frohe et al., 2020; Patock-Peckham & colleagues 2018; 2020), and prospectively predicts alcohol use disorder (AUD; Leeman et al., 2009; Patock-Peckham et al., 2019). Conceivably, IC is a potential mechanism by which stress-sensitive individuals engage in problematic drinking behaviors.

1.3. Cisgender sex differences

According to Park et al. (2020), loneliness has more pronounced negative impacts on cognitive deficits for men than for women. Further, stress reactivity appears to differ between men and women (Peltier et al., 2019); women are more reactive to stress (Ramchandani et al., 2018). For instance, Patock-Peckham et al.'s (2022) alcohol self-administration study found that women were more likely to engage in heavy episodic drinking after just experiencing an acute stressor (i.e. Trier Social Stress Test; TSST) than were men. In addition, women show substantial increases in dysregulated binge and heavy episodic drinking (Hingson et al., 2017; Guinle & Sinha, 2020). Although men drink more often, in greater quantity, and report more heavy episodic drinking (Nolen-Hoeksema, 2004) women are catching up with alcohol use disorders (AUDs). Grant et al., (2017) reported an 84% increase in AUD among women versus a 35% increase among men in the last decade. Hence, one must control for gender differences in models of loneliness. Albeit we did not have specific predictions regarding our loneliness pathway through stress and IC, regarding cisgender sex differences, we did feel it was wise to include gender as a covariate due to the aforementioned studies above.

1.4. Hypotheses

Based upon Cacioppo et al.'s (2006) Evolutionary Model of Loneliness, sustained loneliness may have long-term effects on stress reactivity. Thus, we predict that childhood loneliness (prior to the age of 12) is positively linked to perceived stress in emerging adulthood. Additionally, in tandem with the Stress Dampening Theory (Marlatt, 1987; Sayette, 1993; Sher, 1987), we hypothesize that there is an indirect relationship between childhood loneliness and alcohol misuse; this link is expected to be mediated by both stress, and in turn, IC. As previous literature has found that IC over drinking is an indirect outcome of adverse childhood experience (Frohe et al., 2020; Noudali et al., 2022; Patock-Peckham et al., 2020), we hypothesize novel direct and indirect relationships between childhood loneliness and IC.

2. Methods

2.1. Participants

Our sample included 310 university students (154 women, 156 men) who were 18 years or older and proficient in English to be able to give informed consent based on the requirement of our local IRB. All participants received 1 h of course credit and the full survey had an average response time of 54 min on the Qualtrics online survey tool. We protected the anonymity of participants by deleting student e-mails and IP addresses after awarding course credit. The consent form stated that the study would ask questions regarding their past and present experiences, personality traits, and substance use. Our sample included 85% current drinkers of alcoholic beverages and 12.3% claiming under aged drinking in their past. The mean age of the sample was 19.32 (SD = 2.62). The sample was 56% Caucasian, 19% Hispanic, 13.4% Asian, 4.2% African American, 1.6% Native American, 1.8% Pacific Islander, and 2.4% reported "other".

2.2. Measures

2.2.1. UCLA loneliness scale

The UCLA loneliness scale (Version 3; Russell et al., 1996; Russell et al., 1980) is a well-validated 20-item questionnaire that measures feelings of perceived social isolation and dissatisfaction with the quality of relationships. We asked the questions prefaced with "before the age of 12" to measure childhood loneliness. The scale includes questions such as "Before the age of 12, how often did you feel isolated from others?" and "Before the age of 12, how often did you feel that people were

around you but not with you?" The response options were rated from 1 (never), 2 (rarely), 3 (sometimes) and 4 (often). The α reliability was 0.97.

2.2.2. Perceived Stress Scale-10

The PSS-10 (Cole, 1999) measures the subjective experience of stress by assessing feelings of discontent with the uncontrollability of life in the past month. The 10-items consist of questions such as "how often have you felt that you were unable to control the important things in your life?" and "how often have you felt nervous or stressed?" The response options are on a 5-point Likert scale ranging from 0 (never) to 4 (very often). The internal reliability was α = 0.81.

2.2.3. Impaired control measure

This study used 10-items from Part III of the Impaired Control Scale (Heather et al., 1993). Part III measures the believed ability, or inability, to limit alcohol consumption when intended. For example, one item is "I would have difficulty limiting the amount I drink." Higher scores reflect a greater lack of perceived control over drinking. Response options range on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The α reliability was 0.85.

2.2.4. Alcohol use (quantity/frequency measure)

We combined the quantity and frequency items into a single scale by converting the frequency levels into equivalent occasions per month, which ranged from 1 = 0.5 times per month to 7 = 28 times per month, and the quantity levels into equivalent grams of alcohol, which ranged from 1 = 10 g a month to 5 = 70 g a month. Next, these values were then multiplied, and the distribution of scores were $\log_{10}$ transformed (Wood et al., 1992).

2.2.5. The young adult alcohol problems screening test

The YAAPST (Hurlbut & Sher, 1992) is a 27-item scale designed to measure the frequency of problematic alcohol usage in college students during the past year. The scale includes questions such as "Have you ever driven a car when you knew you had too much to drink to drive safely?" The 10 response options range from 0 (No, never) to 9 (40 or more times in the past year). The α reliability was 0.89.

2.3. Statistical analysis

A structural equation model was fit with Mplus v8.3 (Muthen & Muthen, 1998–2017) to evaluate our conceptual model displayed in Fig. 1. Comparative fit index (CFI; Bentler, 1990), Root Mean Square Error of Approximation analyses (RMSEA; Browne & Cudeck, 1993; Hu & Bentler, 1998), and chi square statistics were used to determine model fit. The direct and indirect effects between childhood loneliness, stress, impaired-control-over-drinking, and alcohol problems were assessed using mediation analyses, such as the bias corrected bootstrap technique (k = 20,000; Efron & Tibshirani, 1993) and 95% confidence intervals around the estimates (Hancock & Liu, 2012, MacKinnon, 2008; Tofighi & MacKinnon, 2011). We also examined our model with both the ML (maximum likelihood) as well as the MLR estimator. Bentler (1983) suggested the MLR estimator for non-normally distributed outcome variables in path models. We coded women as zeros and men as ones in our model for the sake of interpretation of the gender effects. Table 1 presents the means, standard deviations, and correlations among all the variables in the model tested (see Fig. 2.).

3. Results

The model fit indices yielded χ^2 (2 df) = 0.297, p =.862; RMSEA = 0.00; 90% CI (0.00, 0.059); probability of RMSEA < = 0.05 = 0.933; CFI = 1.00; TLI = 1.042. The only difference we noticed between using ML and MLR estimators was that the TLI index dropped from 1.042 to 1.000; beta weights and significant relationships remained the same.

3.1. Indirect effects

3.1.1. Impaired control over drinking (IC)

Higher levels of loneliness as a child were indirectly linked to more IC through more stress [indirect effect = 0.100, S.E. = 0.026, Z = 3.816, p <.001, 95% CI (0.052, 0.155)]. Being male was indirectly linked to less IC through less stress experienced [indirect effect = −0.051, S.E. = 0.022, Z = −2.254, p = 0.024, 95% CI (−0.099, −0.012)]. Therefore, being female was indirectly linked to more IC through more stress.

3.1.2. Alcohol use (quantity/frequency)

Higher levels of loneliness as a child were indirectly linked to more alcohol use through increased stress, and in turn, more IC [indirect effect = 0.024, S.E. = 0.009, Z = 2.836, p =.005, 95% CI (0.010, 0.043)]. Additionally, being male was indirectly linked to less alcohol use through less stress, and in turn, less IC [indirect effect = −0.012, S.E. = 0.006, Z = −1.997, p = 0.046, 95% CI (−0.026, −0.002)]. Conversely, being female was indirectly linked to more alcohol use through increased stress, and in turn, more IC.

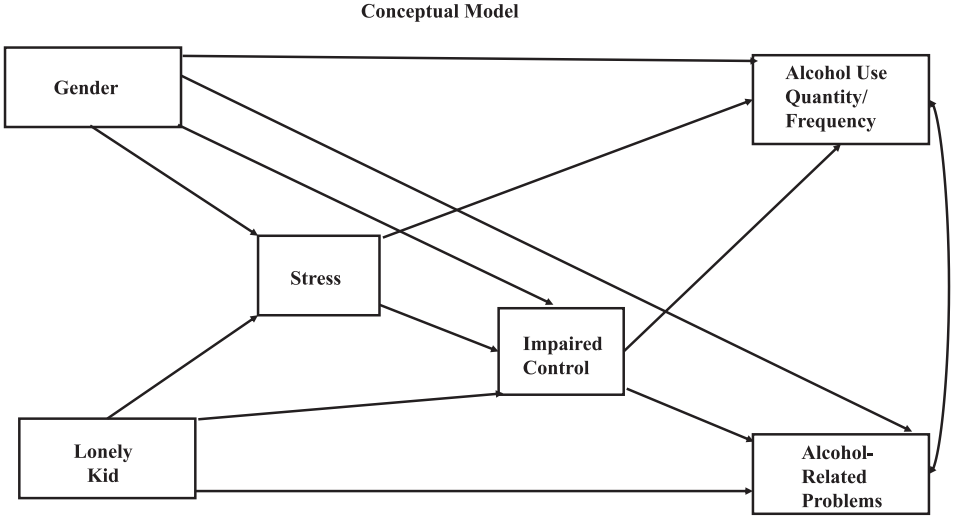

Fig. 1. Conceptual model for all examined paths among the variables in the model.

Table 1
Means, standard deviations, range, skew, kurtosis, and correlations among all variables.

M	SD	Range	Skew	S.E.	Kurtosis	Measures	1	2	3	4	5	6
0.98	(0.83)	(0.00, 2.95)	0.533	0.138	−0.77	1. Loneliness	1.00					
2.67	(0.60)	(1.30, 4.40)	0.019	0.141	−3.87	2. Stress	0.46	1.00				
1.65	(0.74)	(1.00, 4.10)	1.159	0.148	0.66	3. Impaired Control	0.02	0.21	1.00			
2.11	(0.69)	(0.70, 3.45)	0.101	0.148	−0.91	4. Alcohol Use	0.01	0.02	0.26	1.00		
1.55	(0.65)	(1.00, 6.00)	2.586	0.148	9.17	5. Alcohol-Related Problems	0.14	0.15	0.48	0.59	1.00	
0.50	(0.49)	(0.00, 1.00)	−0.013	0.138	−2.013	6. Gender	−0.11	−0.18	0.05	0.12	0.08	1.00

N = 310. Please note that 85.5% of our sample identified themselves as current drinkers of alcoholic beverages. According to Brown (2006) skew of + or – 3 and kurtosis of + or – 10 is acceptable for SEM models. Thus, our kurtosis for alcohol-related problems is slightly elevated here likely due to the large numbers of individuals in our college sample identifying as a current drinker and all individuals in the sample endorsing at least one alcohol consequence experienced by age 19. However, a range from (1.00, 6.00) alcohol-related problems is not sufficient evidence that there were extreme scores present in our sample. Furthermore, when the MLR estimator was utilized [as suggested by Bentler (1983) using the Santorra-Bentler Chi-Square for non-normally distributed variables] instead of the ML default we observed no meaningful changes to our model or model interpretation.

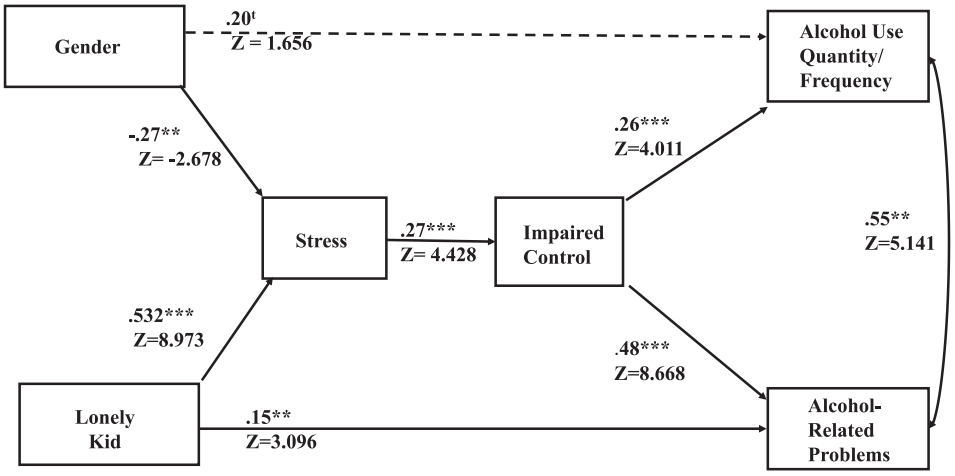

Fig. 2. Fit path model for 310 participants. Standardized coefficients are shown for all participants and Z scores are in the model; * p <.05; ** p <.01; *** p <.001.

3.1.3. Alcohol-related problems

Higher levels of loneliness as a child were indirectly linked to more alcohol-related problems through more stress, and in turn, more IC [indirect effect = 0.042, S.E. = 0.013, Z = 3.150, p =.002, 95% CI (0.020, 0.072)]. Being male was indirectly linked to less alcohol-related problems through less stress, and in turn, less IC [indirect effect- −0.021, S.E. = 0.010, Z = −2.087, p = 0.037, 95% CI (−0.045, −0.005)]. Therefore, being female was indirectly linked to more alcohol-related problems through more stress, and in turn, more impaired-control-over-drinking.

4. Discussion

Cacioppo's Evolutionary Theory (2006) suggests that lonely individuals have deficits in execute functioning, impulsivity control, as well as experience more physical pain (Cacioppo et al., 2009; Baumeister et al., 2005). This study presents novel insights towards childhood loneliness direct and indirect associations with impaired-control-over-alcohol (IC), alcohol use, and alcohol-related problems. We add to the existing literature by extending loneliness-related problems in self-regulation to IC. Albeit some previous research has shown that lonely individuals tend to drink more (Mckay et al., 2017; Pursor, 2020), evidence has been inconsistent (Cacioppo et al., 2002; Chen & Feeley, 2015). Our study helps reconcile these inconsistencies by finding some of the mechanisms by which loneliness indirectly predicts alcohol-related problems. Perceived stress mediated the indirect link between childhood loneliness and IC. Our findings are consistent with previous literature which links adverse childhood experience to problematic drinking outcomes in emerging adulthood (Kendall-Tackett, 2002; Rothman et al., 2008), but are also novel as they present a stress mediated pathway by which childhood loneliness results in dysregulated drinking.

This is the first study to show mechanisms of IC in the context of loneliness. Childhood loneliness was indirectly and positively associated to IC through increased perceived stress. Our findings are consistent with Fox et al. (2010) who suggested that impulsivity and stress increase problematic alcohol use. Strickland & Johnson (2021) suggest that rather than using a global impulsivity construct to use the context associated with each behavioral decision. Impaired control considers the decision specific to the drinking context (Patock-Peckham & colleagues 2001; 2006; 2011; 2018; 2020; 2022). Similar to other studies, IC was associated with an increase in quantity and in frequency of alcohol consumption as well as alcohol-related problems (Frohe et al., 2020; Noudali et al., 2022; Patock-Peckham et al., 2020). The Theory of Loneliness (Cacioppo et al., 2006) suggests that, when sustained, loneliness heightens cognitive, emotional, and neurophysiological dysregulation, and our study extends these implications to the dysregulation of drinking as well.

Our study supports the Stress Dampening Theory (Marlatt, 1987; Sher, 1987), which posits that alcohol functions as a self-regulatory mechanism used to relieve negative affect. Consistent with Ayer et al. (2011), we found perceived stress was related to more problematic drinking outcomes especially among women. This is also consistent with recent alcohol self-administration studies in which an acute social evaluative stressor was used (Patock-Peckham et al., 2022). The present findings are better able to characterize the positive association between stress and alcohol consumption. Individuals who had lonely childhoods are more reactive to stress (Nowland et al., 2018; Brown et al., 2018) and may not have learned appropriate coping mechanisms (Qualter et al., 2009). This pattern of relationships was more pronounced among

women. Therefore, our model shows how dysregulated alcohol consumption may be used to reduce perceived stress particularly among the lonely.

Our study examined how childhood loneliness predicts increased stress in emerging adulthood, and the pathway by which alcohol is misused to alleviate that stress. In tandem, we found that greater childhood loneliness predicted greater perceived stress among emerging adults. Additionally, we found that women reported greater levels of stress, which is consistent with other researchers (Peltier et al., 2019; Ramchandani et al., 2018). Consistent with the Stress Dampening Theory (Marlatt, 1987; Sayette, 1993; Sher, 1987), stress mediated the pathway to IC, and in turn, alcohol-related problems. Our loneliness model provides novel mechanisms by which childhood loneliness prior to the age of 12 predicts alcohol misuse through the stress to the impaired control pathway.

4.1. Limitations

Despite our study's novel finding(s) regarding childhood loneliness and drinking outcomes, it has several limitations. One limitation to this study was the retrospective nature of self-reported childhood loneliness. Although retrospective reports of childhood adversity are generally reliable, such accounts are subject to recall bias (Hardt & Rutter, 2004). The study was also cross-sectional and could only show exploratory associations. Because of the differences between the effects of momentary and enduring loneliness, future research should measure loneliness longitudinally. Additionally, due to the variability in the trajectories of loneliness throughout the stages of development (Vanhalst et al., 2018), the occurrence and the effects of loneliness may not have been limited to childhood. Therefore, measuring loneliness at multiple time points would be a logical next step. Next, the relationship between stress and loneliness could be bidirectional (Doane & Thurston, 2014) and our model only addresses a loneliness to stress direction. It would also be prudent to replicate these findings with a more normally distributed measure of alcohol-related problems than what we utilized here. Moreover, the Stress Dampening Theory (Marlatt, 1987; Sayette, 1993; Sher, 1987) of alcohol consumption inspired our study, yet we did not include measurements of drinking motives (Cooper et al., 1992a; 1992b). Future studies should include drinking motives.

4.2. Conclusions

Our study provides novel evidence for the Stress Dampening Hypothesis (Marlatt, 1987; Sher, 1987) implicating childhood loneliness as a direct and indirect predictor of alcohol-related problems. Higher levels of loneliness in childhood prior to age 12 directly predicted alcohol-related problems in emerging adulthood and indirectly predicted greater dysregulated alcohol consumption through a perceived stress pathway. Through stress, childhood loneliness predicted more impaired-control-over-drinking. Impaired control has longitudinally predicted AUD in previous studies (Leeman et al., 2009; Patock-Peckham et al., 2019) as well as problematic drinking outcomes. Therefore, our model has clinical implications. Intervening in childhood loneliness could prove useful in inhibiting the pathway to emerging adulthood alcohol misuse. Childhood interventions that target social and emotional regulation skills have been effective in preventing transient loneliness from becoming debilitating and chronic (Eccles & Qualter, 2020; Qualter et al., 2015). Our study presents novel evidence for a stress-mediated pathway between childhood loneliness and dysregulated alcohol use. The findings suggest that perceived stress is an important target of intervention for those with AUDs, especially among women.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. However, Dr. William Corbin should not be asked to review this manuscript because he has served as a mentor to the second author on her K01 grant.

Acknowledgments

NIH/NIAAA award number K01 AA024160-01A1 and Burton Family Foundation award number FP11815 to Julie A. Patock-Peckham. We also thank David Prince and Intel Corporation, Chris and Michelle Barwick and Cisco corporation, Clayton and & Stacy Story, Matthew Broussard, Giannine and John Doyle, Joy Solon Weber, Brian Jefferies and The East Valley Firefighters Charitable Foundation, and Tim and Gail Buchanan, for their financial support to the lab.

References

Asher, S. R., & Paquette, J. A. (2003). Loneliness and peer relations in childhood. *Current Directions in Psychological Science*, *12*, 75–78. 8721.01233.

Ayer, L. A., Harder, V. S., Rose, G. L., & Helzer, J. E. (2011). Drinking and stress: An examination of sex and stressor differences using IVR-based daily data. *Drug and Alcohol Dependence, 115*(3), 205–212. https://doi.org/10.1016/j.drugalcdep.2010.10.022

Baumeister, R. F., DeWall, C. N., Ciarocco, N. J., & Twenge, J. M. (2005). Social exclusion impairs self-regulation. *Journal of Personality and Social Psychology, 88*(4), 589. https://doi.org/10.1037/0022-3514.88.4.589

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin, 117*(3), 497. https://doi.org/10.1037/0033-2909.117.3.497

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107*(2), 238–246. https://doi.org/10.1037/0033-2909.107.2.238

Bickel, W. K., & Marsch, L. A. (2001). Toward a behavioral economic understanding of drug dependence: Delay discounting processes. *Addiction, 96*(1), 73–86. https://doi.org/10.1046/j.1360-0443.2001.961736.x

Brown, T. A. (2006). *Confirmatory factor analysis for applied research*. New York, NY: Guilford Press.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen, & J. S. Long (Eds.), *Testing structural equation models* (pp. 136–162). Newbury Park, CA: Sage.

Brown, E. G., Gallagher, S., & Creaven, A. M. (2018). Loneliness and acute stress reactivity: A systematic review of psychophysiological studies. *Psychophysiology, 55*(5), 1–14. https://doi.org/10.1111/psyp.13031

Cacioppo, J. T., & Cacioppo, S. (2018). Loneliness in the modern age: an evolutionary theory of loneliness (ETL). In *Advances in experimental social psychology* (Vol. 58, pp. 127-197). Academic Press. https://doi.org/10.1016/bs.aesp.2018.03.003.

Cacioppo, J. T., Ernst, J. M., Burleson, M. H., McClintock, M. K., Malarkey, W. B., Hawkley, L. C., … Spiegel, D. (2000). Lonely traits and concomitant physiological processes: The MacArthur social neuroscience studies. *International Journal of Psychophysiology, 35*(2–3), 143–154. https://doi.org/10.1016/S0167-8760(99)00049-5

Cacioppo, J. T., Hawkley, L. C., Crawford, L. E., Ernst, J. M., Burleson, M. H., Kowalewski, R. B., … Berntson, G. G. (2002). Loneliness and health: Potential mechanisms. *Psychosomatic Medicine, 64*(3), 407–417. https://doi.org/10.1097/00006842-200205000-00005

Cacioppo, J. T., Hawkley, L. C., Ernst, J. M., Burleson, M., Berntson, G. G., Nouriani, B., & Spiegel, D. (2006). Loneliness within a nomological net: An evolutionary perspective. *Journal of Research in Personality, 40*(6), 1054–1085. https://doi.org/10.1016/j.jrp.2005.11.007

Cacioppo, J. T., Norris, C. J., Decety, J., Monteleone, G., & Nusbaum, H. (2009). In the eye of the beholder: Individual differences in perceived social isolation predict regional brain activation to social stimuli. *Journal of Cognitive Neuroscience, 21*(1), 83–92. https://doi.org/10.1162/jocn.2009.21007

Canning, J. R., Patock-Peckham, J. A., Walters, K. J., Bauman, D. C., Frohe, T., & Leeman, R. F. (2020). Perfectionism discrepancy and falling short of the ideal self: Investigating drinking motives and impaired control on the road to alcohol-related problems. *Personality and Individual Differences, 159*, Article 109909. https://doi.org/10.1016/j.paid.2020.109909

Chen, Y., & Feeley, T. H. (2015). Predicting binge drinking in college students: Rational beliefs, stress, or loneliness? *Journal of Drug Education, 45*(3–4), 133–155. https://doi.org/10.1177/0047237916639812

Cole, S. R. (1999). Assessment of differential item functioning in the Perceived Stress Scale-10. *Journal of Epidemiology and Community Health, 53*(5), 319–320. https://doi.org/10.1136/jech.53.5.319

Cooper, M. L., Russell, M., Skinner, J. B., Frone, M. R., & Mudar, P. (1992). Stress and alcohol use: Moderating effects of gender, coping, and alcohol expectancies. *Journal of Abnormal Psychology, 101*(1), 139. https://doi.org/10.1037/0021-843X.101.1.139

Cooper, M. L., Russell, M., Skinner, J. B., & Windle, M. (1992). Development and validation of a three-dimensional measure of drinking motives. *Psychological Assessment, 4*(2), 123–132. https://doi.org/10.1037/1040-3590.4.2.123

Courtin, E., & Knapp, M. (2017). Social isolation, loneliness and health in old age: A scoping review. *Health & Social Care in the Community, 25*(3), 799–812. https://doi.org/10.1111/hsc.12311

Cyders, M. A., VanderVeen, J. D., Plawecki, M., Millward, J. B., Hays, J., Kareken, D. A., & O'Connor, S. (2016). Gender-specific effects of mood on alcohol-seeking behaviors: Preliminary findings using intravenous alcohol self-administration. *Alcoholism: Clinical and Experimental Research, 40*(2), 393–400. https://doi.org/10.1111/acer.12955

Doane, L. D., & Adam, E. K. (2010). Loneliness and cortisol: Momentary, day-to-day, and trait associations. *Psychoneuroendocrinology, 35*(3), 430–441. https://doi.org/10.1016/j.psyneuen.2009.08.005

Doane, L. D., & Thurston, E. C. (2014). Associations among sleep, daily experiences, and loneliness in adolescence: Evidence of moderating and bidirectional pathways. *Journal of Adolescence, 37*(2), 145–154. https://doi.org/10.1016/j.adolescence.2013.11.009

Eccles, A. M., & Qualter, P. (2020). Alleviating loneliness in young people–a meta-analysis of interventions. *Child and Adolescent Mental Health*. https://doi.org/10.1111/camh.12389

Efron, B., & Tibshirani, R. J. (1993). An Introduction to the Bootstrap. *Chapman and Hall, New York.*. https://doi.org/10.1007/978-1-4899-4541-9

Eisenberg, N. (2003). Prosocial behavior, empathy, and sympathy. In M. H. Bornstein, L. Davidson, C. L. M. Keyes, & K. A. Moore (Eds.), *Well-being: Positive development across the life course* (pp. 253–265). Lawrence Erlbaum Associates Publishers.

Fox, H., Bergquist, K., Gu, P., & Sinha, R. (2010). Interactive effects of cumulative stress and impulsivity on alcohol consumption. *Alcoholism: Clinical & Experimental Research, 34*(8), 1376–1385. https://doi.org/10.1111/j.1530-0277.2010.01221.x

Frohe, T., Leeman, R. F., Cheong, J., Belton, D. A., & Patock-Peckham, J. A. (2020). Novel associations among trauma, mindfulness, and impaired control over alcohol use. *Mindfulness, 11*(3), 606–614. https://doi.org/10.1007/s12671-019-01285-6

Goldman, N., Glei, D. A., Seplaki, C., I-Wen, L., & Weinstein, M. (2005). Perceived stress and physiological dysregulation in older adults. Stress: *The International Journal on the Biology of Stress*, *8*, 95–105. https://doi.org/10.1080/10253890500141905.

Grant, B. F., Chou, S. P., Saha, T. D., Pickering, R. P., Kerridge, B. T., Ruan, W. J., Huang, B., Jung, J., Zhang, H., Fan, A., & Hasin, D. S. (2017). Prevalence of 12-month alcohol use, high-risk drinking, and DSM-IV alcohol use disorder in the United States, 2001–2002 to 2012–2013: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *JAMA Psychiatry, 74*(9), 911–923. https://doi.org/10.1001/jamapsychiatry.2017.2161

Guinle, M. I. B., & Sinha, R. (2020). The role of stress, trauma, and negative affect in alcohol misuse and alcohol use disorder in women. *Alcohol Research: Current Reviews, 40*(2), Article 5. https://doi.org/10.35946/arcr.v40.2.05.

Hancock, G. R., & Liu, M. (2012). Bootstrapping standard errors and data-model fit statistics in structural equation modeling. In R. H. Hoyle (Ed.), *Handbook of structural equation modeling* (pp. 296–306). The Guilford Press.

Hardt, J., & Rutter, M. (2004). Validity of adult retrospective reports of adverse childhood experiences: Review of the evidence. *Journal of Child Psychology and Psychiatry, 45*(2), 260–273. https://doi.org/10.1111/j.1469-7610.2004.00218.x

Harris, R. A., Qualter, P., & Robinson, S. J. (2013). Loneliness trajectories from middle childhood to pre-adolescence: Impact on perceived health and sleep disturbance. *Journal of Adolescence, 36*(6), 1295–1304. https://doi.org/10.1016/j.adolescence.2012.12.009

Hawkley, L. C., Burleson, M. H., Berntson, G. G., & Cacioppo, J. T. (2003). Loneliness in everyday life: Cardiovascular activity, psychosocial context, and health behaviors. *Journal of Personality and Social Psychology, 85*(1), 105. https://doi.org/10.1037/0022-3514.85.1.105

Hawkley, L. C., Masi, C. M., Berry, J. D., & Cacioppo, J. T. (2006). Loneliness is a unique predictor of age-related differences in systolic blood pressure. *Psychology and Aging, 21*(1), 152–164. https://doi.org/10.1037/0882-7974.21.1.152

Heather, N., Tebbutt, J. S., Mattick, R. P., & Zamir, R. (1993). Development of a scale for measuring impaired control over alcohol consumption: A preliminary report. *Journal of Studies on Alcohol, 54*(6), 700–709. https://doi.org/10.15288/jsa.1993.54.700.

Heinrich, L. M., & Gullone, E. (2006). The clinical significance of loneliness: A literature review. *Clinical Psychology Review, 26*(6), 695–718. https://doi.org/10.1016/j.cpr.2006.04.002

Higgins, R. L., & Marlatt, G. A. (1973). Effects of anxiety arousal on the consumption of alcohol by alcoholics and social drinkers. *Journal of Consulting and Clinical Psychology, 41*(3), 426–433. https://doi.org/10.1037/h0035366

Hingson, R., Zha, W., & Smyth, D. (2017). Magnitude and trends in heavy episodic drinking, alcohol-impaired driving, and alcohol-related mortality and overdose hospitalizations among emerging adults of college ages 18–24 in the United States, 1998–2014. *Journal of Studies on Alcohol and Drugs, 78*(4), 540–548. https://doi.org/10.15288/jsad.2017.78.540.

Hu, L. T., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods, 3*(4), 424–453. https://doi.org/10.1037/1082-989X.3.4.424

Huang, L. J., Du, W. T., Liu, Y. C., Guo, L. N., Zhang, J. J., Qin, M. M., & Liu, K. (2019). Loneliness, stress, and depressive symptoms among the Chinese rural empty nest elderly: A moderated mediation analysis. *Issues in mental health nursing, 40*(1), 73–78. https://doi.org/10.1080/01612840.2018.1437856

Hurlbut, S. C., & Sher, K. J. (1992). Assessing alcohol problems in college students. *Journal of American College Health, 41*(2), 49–58. https://doi.org/10.1080/07448481.1992.10392818

Hussong, A. M., & Chassin, L. (1994). The stress-negative affect model of adolescent alcohol use: Disaggregating negative affect. *Journal of Studies on Alcohol, 55*(6), 707–718. https://doi.org/10.15288/jsa.1994.55.707.

Jones, A. C., Schinka, K. C., van Dulmen, M. H., Bossarte, R. M., & Swahn, M. H. (2011). Changes in loneliness during middle childhood predict risk for adolescent suicidality indirectly through mental health problems. *Journal of Clinical Child & Adolescent Psychology, 40*(6), 818–824. https://doi.org/10.1080/15374416.2011.614585

Kendall-Tackett, K. (2002). The health effects of childhood abuse: Four pathways by which abuse can influence health. *Child Abuse & Neglect, 26*(6–7), 715–729. https://doi.org/10.1016/S0145-2134(02)00343-5

Ladd, G. W., & Ettekal, I. (2013). Peer-related loneliness across early to late adolescence: Normative trends, intra-individual trajectories, and links with depressive symptoms. *Journal of Adolescence, 36*(6), 1269–1282. https://doi.org/10.1016/j.adolescence.2013.05.004

Leeman, R. F., Fenton, M., & Volpicelli, J. R. (2007). Impaired control and undergraduate problem drinking. *Alcohol and Alcoholism, 42*(1), 42–48. https://doi.org/10.1093/alcalc/agl095

Leeman, R. F., Patock-Peckham, J. A., & Potenza, M. N. (2012). Impaired control over alcohol use: An under-addressed risk factor for problem drinking in young adults? *Experimental and Clinical Psychopharmacology, 20*(2), 92. https://doi.org/10.1037/a0026463

Leeman, R. F., Toll, B. A., Taylor, L. A., & Volpicelli, J. R. (2009). Alcohol-induced disinhibition expectancies and impaired control as prospective predictors of problem drinking in undergraduates. *Psychology of Addictive Behaviors, 23*(4), 553. https://doi.org/10.1037/a0021068

MacKinnon, D. P. (2008). Introduction to statistical mediation analysis. Taylor & Francis Group/Lawrence Erlbaum Associates.

Marlatt, G. A. (1987). Alcohol, the magic elixir: Stress, expectancy, and the transformation of emotional states. In E. Gottheil, K. A. Druley, S. Pashko, & S. P. Weinstein (Eds.), *Stress and Addiction* (pp. 302–322). Brunner/Mazel.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review, 50*(4), 370–396. https://doi.org/10.1037/h0054346

McGrath, E., Jones, A., & Field, M. (2016). Acute stress increases ad-libitum alcohol consumption in heavy drinkers, but not through impaired inhibitory control. *Psychopharmacology (Berl), 233*, 1227–1234. https://doi.org/10.1007/s00213-016-4205-1

McHugh, J. E., & Lawlor, B. A. (2013). Perceived stress mediates the relationship between emotional loneliness and sleep quality over time in older adults. *British Journal of Health Psychology, 18*(3), 546–555. https://doi.org/10.1111/j.2044-8287.2012.02101.x

McKay, M. T., Konowalczyk, S., Andretta, J. R., & Cole, J. C. (2017). The direct and indirect effect of loneliness on the development of adolescent alcohol use in the United Kingdom. *Addictive Behaviors Reports, 6*, 65–70. https://doi.org/10.1016/j.abrep.2017.07.003

Muthén, L. K., & Muthén, B. (1998-2017). Mplus User's Guide. Los Angeles, CA: Muthén & Muthén.

Nolen-Hoeksema, S. (2004). Gender differences in risk factors and consequences for alcohol use and problems. *Clinical Psychology Review, 24*(8), 981–1010. https://doi.org/10.1016/j.cpr.2004.08.003

Noudali, S. N., Patock-Peckham, J. A., Berberian, S. L., Belton, D. A., Campbell, L. E., & Infurna, F. J. (2022). Does insomnia mediate the link between childhood trauma and impaired control over drinking, alcohol use, and related problems? *Addictive Behaviors Reports, 15*, Article 100402. https://doi.org/10.1016/j.abrep.2021.100402

Nowland, R., Robinson, S. J., Bradley, B. F., Summers, V., & Qualter, P. (2018). Loneliness, HPA stress reactivity and social threat sensitivity: Analyzing naturalistic social challenges. *Scandinavian Journal of Psychology, 59*(5), 540–546. https://doi.org/10.1111/sjop.12461

Ong, A. D., Rothstein, J. D., & Uchino, B. N. (2012). Loneliness accentuates age differences in cardiovascular responses to social evaluative threat. *Psychology and Aging, 27*(1), 190–198. https://doi.org/10.1037/a0025570

Park, C., Majeed, A., Gill, H., Tamura, J., Ho, R. C., Mansur, R. B., … McIntyre, R. S. (2020). The effect of loneliness on distinct health outcomes: A comprehensive review and meta-analysis. *Psychiatry Research, 294*, Article 113514. https://doi.org/10.1016/j.psychres.2020.113514

Patock-Peckham, J. A., Belton, D. A., D'Ardenne, K., Tein, J. Y., Bauman, D. C., Infurna, F. J., & McClure, S. M. (2020). Dimensions of childhood trauma and their direct and indirect links to PTSD, impaired control over drinking, and alcohol-related-problems. *Addictive Behaviors Reports, 12*, Article 100304. https://doi.org/10.1016/j.abrep.2020.100304

Patock-Peckham, J. A., Canning, J. R., & Leeman, R. F. (2018). Shame is bad and guilt is good: An examination of the impaired control over drinking pathway to alcohol use and related problems. *Personality and Individual Differences, 121*, 62–66. https://doi.org/10.1016/j.paid.2017.09.023

Patock-Peckham, J. A., Cheong, J., Balhorn, M. E., & Nagoshi, C. T. (2001). A social learning perspective: A model of parenting styles, self-regulation, perceived drinking control, and alcohol use and problems. *Alcoholism: Clinical and Experimental Research, 25*(9), 1284–1292. https://doi.org/10.1111/j.1530-0277.2001.tb02349.x

Patock-Peckham, J.A., Bauman, D.C., Waddell, J.T., & Corbin, W.R. (June, 2019). Impaired control over drinking predicts changes in alcohol-related consequences over and above alcohol use and facets of impulsivity. Poster presented at the 42nd annual conference of Research Society on Alcoholism, Minneapolis, MN.

Patock-Peckham, J. A., Corbin, W. R., Smyth, H., Canning, J. R., Ruof, A., & Williams, J. (2022). Effects of stress, alcohol prime dose, and sex on ad libitum drinking. *Psychology of Addictive Behaviors.* Advance online publication. https://doi.org/10.1037/adb0000801.

Patock-Peckham, J. A., King, K. M., Morgan-Lopez, A. A., Ulloa, E. C., & Filson Moses, J. M. (2011). Gender-specific mediational links between parenting styles, parental monitoring, impulsiveness, drinking control, and alcohol-related problems. *Journal of Studies on Alcohol and Drugs, 72*(2), 247–258. https://doi.org/10.15288/jsad.2011.72.247.

Patock-Peckham, J. A., & Morgan-Lopez, A. A. (2006). College drinking behaviors: Mediational links between parenting styles, impulse control, and alcohol-related

outcomes. *Psychology of Addictive Behaviors, 20*(2), 117. https://doi.org/10.1037/0893-164X.20.2.117

Peltier, M. R., Verplaetse, T. L., Mineur, Y. S., Petrakis, I. L., Cosgrove, K. P., Picciotto, M. R., & McKee, S. A. (2019). Sex differences in stress-related alcohol use. *Neurobiology of Stress, 10*, Article 100149. https://doi.org/10.1016/j.ynstr.2019.100149

Peplau, L. A., & Perlman, D. (1979, June). Blueprint for a social psychological theory of loneliness. In Love and attraction: An interpersonal conference (pp. 101-110). New York: Pergamon Press.

Qualter, P., Brown, S. L., Munn, P., & Rotenberg, K. J. (2010). Childhood loneliness as a predictor of adolescent depressive symptoms: An 8-year longitudinal study. *European Child & Adolescent Psychiatry, 19*(6), 493–501. https://doi.org/10.1007/s00787-009-0059-y

Qualter, P., Brown, S. L., Rotenberg, K. J., Vanhalst, J., Harris, R. A., Goossens, L., … Munn, P. (2013). Trajectories of loneliness during childhood and adolescence: Predictors and health outcomes. *Journal of Adolescence, 36*(6), 1283–1293. https://doi.org/10.1016/j.adolescence.2013.01.005

Qualter, P., Quinton, S. J., Wagner, H., & Brown, S. (2009). Loneliness, interpersonal distrust, and alexithymia in university students. *Journal of Applied Social Psychology, 39*(6), 1461–1479. https://doi.org/10.1111/j.1559-1816.2009.00491.x

Qualter, P., Rotenberg, K., Barrett, L., Henzi, P., Barlow, A., Stylianou, M., & Harris, R. A. (2013). Investigating hypervigilance for social threat of lonely children. *Journal of Abnormal Child Psychology, 41*(2), 325–338. https://doi.org/10.1007/s10802-012-9676-x

Qualter, P., Vanhalst, J., Harris, R., Van Roekel, E., Lodder, G., Bangee, M., … Verhagen, M. (2015). Loneliness across the life span. *Perspectives on Psychological Science, 10*(2), 250–264. https://doi.org/10.1177/1745691615568999

Ramchandani, V. A., Stangl, B. L., Blaine, S. K., Plawecki, M. H., Schwandt, M. L., Kwako, L. E., … Zakhari, S. (2018). Stress vulnerability and alcohol use and consequences: From human laboratory studies to clinical outcomes. *Alcohol, 72*, 75–88. https://doi.org/10.1016/j.alcohol.2018.06.001

Rilling, J. K., Gutman, D. A., Zeh, T. R., Pagnoni, G., Berns, G. S., & Kilts, C. D. (2002). A neural basis for social cooperation. *Neuron, 35*(2), 395–405. https://doi.org/10.1016/S0896-6273(02)00755-9

Rothman, E. F., Edwards, E. M., Heeren, T., & Hingson, R. W. (2008). Adverse childhood experiences predict earlier age of drinking onset: Results from a representative US sample of current or former drinkers. *Pediatrics, 122*(2), e298–e304. https://doi.org/10.1542/peds.2007-3412

Russell, D. W. (1996). UCLA Loneliness Scale (Version 3): Reliability, validity, and factor structure. *Journal of Personality Assessment, 66*(1), 20–40. https://doi.org/10.1207/s15327752jpa6601_2

Russell, D., Peplau, L. A., & Cutrona, C. E. (1980). The revised UCLA Loneliness Scale: Concurrent and discriminant validity evidence. *Journal of Personality and Social Psychology, 39*(3), 472. https://doi.org/10.1037/0022-3514.39.3.472

Sayette, M. A. (1993). An appraisal-disruption model of alcohol's effects on stress responses in social drinkers. *Psychological Bulletin, 114*(3), 459. https://doi.org/10.1037/0033-2909.114.3.459

Schinka, K. C., van Dulmen, M. H., Mata, A. D., Bossarte, R., & Swahn, M. (2013). Psychosocial predictors and outcomes of loneliness trajectories from childhood to early adolescence. *Journal of Adolescence, 36*(6), 1251–1260. https://doi.org/10.1016/j.adolescence.2013.08.002

Sher, K. J. (1987). Stress response dampening. *Psychological theories of drinking and alcoholism*, In HT Blane and KE Leonarad (Eds). Guilford Press, New York. Pages. 227-271.

Steptoe, A., Owen, N., Kunz-Ebrecht, S. R., & Brydon, L. (2004). Loneliness and neuroendocrine, cardiovascular, and inflammatory stress responses in middle-aged men and women. *Psychoneuroendocrinology, 29*(5), 593–611. https://doi.org/10.1016/S0306-4530(03)00086-6

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

Thomas, S. E., Bacon, A. K., Randall, P. K., Brady, K. T., & See, R. E. (2011). An acute psychosocial stressor increases drinking in non-treatment-seeking alcoholics. *Psychopharmacology (Berl), 218*(1), 19–28. https://doi.org/10.1007/s00213-010-2163-6

Tofighi, D., & MacKinnon, D. P. (2011). RMediation: An R package for mediation analysis confidence intervals. *Behavior research methods, 43*(3), 692–700. https://doi.org/10.3758/s13428-011-0076-x

Vanhalst, J., Luyckx, K., Van Petegem, S., & Soenens, B. (2018). The detrimental effects of adolescents' chronic loneliness on motivation and emotion regulation in social situations. *Journal of Youth and Adolescence, 47*(1), 162–176. https://doi.org/10.1007/s10964-017-0686-4

Wardell, J. D., Quilty, L. C., & Hendershot, C. S. (2016). Impulsivity, working memory, and impaired control over alcohol: A latent variable analysis. *Psychology of Addictive Behaviors, 30*(5), 544–554. https://doi.org/10.1037/adb0000186

Wood, M. D., Nagoshi, C. T., & Dennis, D. A. (1992). Alcohol norms and expectations as predictors of alcohol use and problems in a college student sample. *The American Journal of Drug and Alcohol Abuse, 18*(4), 461–476. https://doi.org/10.3109/00952999209051042