Social Support Moderates the Rate of Transition between Alcohol Use Initiation and Depression

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Abstract

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Alcohol use and depression are well-documented to be highly correlated, with adolescent alcohol use predicting adult depression. However, the rate of developing depression after alcohol initiation, and factors that reduce the rate of development, are under researched. Higher social support is independently linked to reduced alcohol use and reduced depression, suggesting that it may slow the rate of developing depression after alcohol initiation. We used data from five years of the accelerated longitudinal cohort National Consortium on Alcohol and Neurodevelopment in Adolescence (NCANDA) study (beginning 2012), participants of which were recruited from five sites across the United States (University of California San Diego, Duke University, Oregon Health & Science University, University of Pittsburgh, SRI International). NCANDA participants **(n=831, aged 12-21, 51% female at baseline)** were recruited to mirror national-level representation regarding race, ethnicity, and sex, oversampling for participants with family histories of problematic alcohol use. Survival analysis was applied to estimate the typical time (i.e., months) to depression onset (i.e., CES-D-10 score of 10 or higher) following age at alcohol use initiation (i.e., first alcoholic drink), age at first regular drinking period (i.e., first period of drinking at least once a week), and age at first binge drinking episode (i.e., first time consuming

at least 4 or 5 drinks in one period). Moderation by social support was tested across models to determine the extent to which social support might buffer the rate of heterotypic transition. Participants who drank before experiencing depression were included (n=509, female=255, Mage=16.98). Higher social support was associated with a seven percent decreased rate of reaching the CES-D-10 threshold for depression after the first drink (HR 0.93, 95% CI [0.88, 0.98], p=0.001) and the first binge drinking episode (HR 0.93, 95% CI [0.87-0.98], p=0.009), but not the first regular drinking period or after controlling for demographics. Women reached depression significantly more quickly than men after the first drink (HR 0.57, 95% CI [0.4, 0.82], p=0.002) and the first binge drinking episode (HR 0.55, 95% CI [0.36, 0.85], p=0.006). As such, people with lower social support during the period following early drinking are not just vulnerable to experiencing depression, but they may also experience a faster onset and thus more long-term consequences (i.e., longer period of depression, additive or cascading symptoms).
Keywords: depression, alcohol, social support, survival, adolescent

Introduction

Both alcohol use and internalizing problems are highly prevalent among young people. About one quarter of adolescents consume at least one full drink of alcohol by age 15, with 14 percent binge drinking when they drink.[1-2] Additionally, rates of depression are similar, with an estimated 17 percent of adolescents reporting at least one major depressive episode in 2020.[3] Both heavy alcohol use and depression cost individuals and the government alike. In addition to negative outcomes for people with depression or excess drinking (e.g., healthcare expenses, troubles with the law, and suicide–the fourth leading cause of death in adolescents), the United States spent $223.5 billion on excessive drinking in 2006 and $71 billion to treat depression, according to a 2013 study.[4-7] Despite their prevalence as distinct problems with separate etiologies and consequences, alcohol use problems and depression often emerge in the same person. Sixty-four percent of people with problematic alcohol use (e.g., high frequency, dependence) experience depression, and lifetime incidence of depression correlates with higher levels of alcohol use.[8-15]

One challenge for addressing these problems and their co-occurrence is that they often differ over time and across individuals. For example, the prevalence of depression appears higher in women than men, whereas men drink alcohol at higher volumes and binge drink more often than women.[1-3] Women also have more co-occurring and persistent depression and alcohol use problems, and the consequences tend to persist longer in women than men.[18-20] Similarly, forms of problem alcohol use differ across ethnic groups. National surveys indicate that non-Hispanic White adults are more likely to drink heavily, but Hispanic people may be more likely to drink more frequently.[21-22] Depression also seems to vary based on background, seeming to be lowest in men and non-Hispanic Asian adults. However, minority populations and people in a lower

socioeconomic status (SES) are less likely to report psychological distress, so these results could be skewed.[23-25] Accounting for demographic variation in comorbid symptoms and the risk and protective factors that modulate them is necessary to understand the links between sets of symptoms and the problems that accumulate as they interact over time.

To slow the rates of onset and accumulation of problems related to excess drinking and depression comorbidity, it is paramount to identify protective factors that reduce the rate of transition from early development of one problem to subsequent escalation of another (i.e., the rate of accumulation of depression symptoms following initial alcohol use or binge drinking). One malleable target that could buffer the effect of alcohol use on depression is social support, or an individual's appraisal of the emotional support available to them (i.e., who they can rely on, how satisfied they feel with the support).[26] Past studies show that peers have a particularly strong influence at earlier ages, and higher levels of social support are associated with reduced frequency and quantity of drinking.[27-31] Higher perceived social support is also associated with lower depressive symptoms, whereas lower social support is associated with higher likelihood of depressive symptoms.[32-40] Social support has been shown to cross-sectionally moderate the relationship between alcohol use problems and depression as well, suggesting that it may also affect the rates of developing these negative outcomes.[41]

Alongside alcohol use problems and depression symptoms, the type and function of social support varies naturalistically across time (i.e., developmental periods)[42-47] and individuals (e.g., by gender or other demographic characteristics).[48-50] For example, people who begin drinking at an earlier age experience higher levels of depression, which some suggest could be due to higher levels of social isolation because of their drinking.[16-17] In addition, girls tend to turn to social support as a method for coping whereas boys tend to rely on other activities (e.g.,

sports).[50-52] Some cultures may promote more social support seeking than others as well. For example, Hispanic adolescents may be encouraged to seek social interactions when experiencing a conflict while Asian American people are less likely to seek support.[53-54] Given the differences in social support seeking behavior across demographic groups, we expect to see differences in the effects of social support on depression after alcohol initiation as well. Importantly, within and between person differences in social support may account for the rates of transition from alcohol use to depression.

Few studies that examine the relationship between alcohol and depression have evaluated the rates of developing depression following markers of alcohol use and whether social support alters this trajectory. The current study used data from a large longitudinal study tracking alcohol use and depression symptoms in tandem with perceptions of social support at regular intervals from early adolescence (i.e., when alcohol use initiation commonly occurs) to young adulthood (i.e., when rates of both alcohol use and depression typically escalate). Specifically, time-to-event analysis was applied to measure the impact of social support in buffering the rate of onset of the first depression symptom following age at alcohol initiation (i.e., first drink, first regular drinking period, first binge drinking episode). Mapping the amount of time it takes for problems to accumulate as a function of a protective factor like social support can help us draw conclusions about whether and to what degree preventative efforts reliant on that support could be helpful for guiding interventions.

Primary hypothesis: Social support is expected to moderate the rate of accumulating depression symptoms after alcohol initiation, with more social support slowing the rate of depressive symptom onset.

Methods

Participants

Longitudinal data from the National Consortium on Alcohol and Neurodevelopment in Adolescence (NCANDA) study were used for the present analyses. NCANDA aims to map the effects of alcohol on adolescent development through use of annual multimodal analysis across neuroanatomical scans, clinical interviews, self-reports, and neuropsychological assessments. NCANDA purposefully oversampled participants who were at risk for alcohol use (e.g., family history of alcohol use) and recruited nationally-representative samples regarding race, ethnicity, and sex. Participants were contacted for follow-ups via information they gave at baseline (e.g., email, phone). After baseline, follow-up rates from year to year were 93%, 88%, 85%, 79%. Using an accelerated longitudinal design, participants were initially recruited across multiple ages (12-21), oversampling for ages that typically precede the point of alcohol use initiation (i.e., aged 12-15). As a result, 83% of participants did not have prior alcohol experience.[55] At baseline, NCANDA recruited (n=831) participants across five sites in the United States (i.e., Duke University, Oregon Health & Science University, SRI International, University of California San Diego, and University of Pittsburgh). Recruitment by school announcement, public notice, and telephone call began in 2012 and ended in 2013. Participants completed assessments annually, in-person. Only participants who drank before experiencing depression (n=509) were retained in our models (Table 1).

Measurements

Alcohol

The Customary Drinking and Drug Use Record (CDDR) was administered annually to assess alcohol use. The CDDR has been found to have good internal (0.63-0.90) and test-retest (0.83) reliability for measuring alcohol use.[56] This study extracted the age at first drink, age at

first regular drinking period (defined to participants as drinking at least once a week), and age at first binge drinking episode (defined to participants as 4 or more drinks for women and 5 or more drinks for men in one time period). We removed obvious data entry errors (i.e., decimal points in incorrect places) and averaged their ages across timepoints to get the most accurate age of onset.[57]

Depression

The 10-item Centre for Epidemiological Studies Depression Scale (CES-D-10), a shorter version of the CES-D screening tool, was administered annually to measure major depressive disorder symptoms and diagnosis. The CES-D has high internal consistency (0.85) and adequate test-retest reliability (0.45-0.70) in adults and adolescents, with the CES-D-10 matching on well to the 20-item version (kappa=0.97).[58-61] Higher scores on the CES-D-10 correspond to higher severity of symptoms, with a cutoff of 10 being the accepted threshold of significant likelihood of depression.

Social Support

Social support was assessed annually using the Social Support Questionnaire-6 (SSQ6), a 6-item version of the longer SSQ that shows high internal reliability (0.90-0.93).[26] The SSQ6 asks, "*Do you have someone whom you can really count on to be dependable when you need help?*" and, "*Do you have someone whom you can count on to console you when you are very upset?*" In addition to listing each persons' initials and their nature of their relationship, participants indicated how satisfied they feel with both forms of support.

Statistical Methods

Survival analysis was applied to estimate the degree to which social support reduces the time to onset of first depression following earlier alcohol initiation. First, we assessed

proportional hazards to determine whether the Cox model was appropriate. We found that the relative risk was the same over time for all models and that we could therefore use Cox models.[62] Separate Cox proportional hazard models were estimated for each of our initial and outcome events, resulting in three tests to evaluate how social support moderates the rate of developing depression (e.g., CES-D-10 score of 10 and greater) following the age at consumption of the first alcoholic drink, age at the first regular drinking period, and age at the first binge drinking episode, controlling for sex, race and ethnicity, and parent and participant SES (Figure 1). Participants who did not experience depression by the last time point were included and censored (i.e., retained in the model despite not reaching the outcome event in the observation window).[62]

To estimate the effects of social support as a time-dependent moderator, participant data (e.g., SSQ6, CES-D-10, alcohol use) was analyzed using time points from all five years rather than collapsing the scores together as an average. Across all measurements and time points, an average of 15.73% of CES-D-10 measurements were missing, 8.7% of SSQ6 measurements were missing, and 27.2% of youth SES measurements were missing. All demographic information was collected at baseline and was not missing, and only participants who drank were selected and thus no alcohol use measurements were missing. To address missingness, the method with the least amount of bias for longitudinal survival analysis–Multivariate Imputation via Chained Equations (MICE)–was used to impute missing values.[63-67] To correct for multiple tests, a Bonferroni correction was applied such that only p-values less than 0.017 are interpreted.

Results

Descriptive Statistics

Of 613 participants who ever drank (range: 12.93-26.34 years old), 104 were excluded due to developing depression before they drank. Compared to included participants, excluded

participants experienced depression earlier (i.e., age 16.55 vs age 18.33) while they consumed their first drink later (i.e., age 18.21 vs age 16.47), experienced their first regular drinking period later (i.e., age 19.16 vs age 18.78), and engaged in their first binge drinking episode later (i.e., age 18.32 vs age 17.79).

Of all included and excluded participants who drank, 327 (53.34%) endorsed reaching the CES-D-10 threshold of depression. For those who experienced initial depression *after* alcohol use initiation (i.e., included participants), the median time from initiation to first depression episode was 33.8 months (CI [30.2, 36.2]) following the first alcohol drink, 24.4 months (CI [20.2, 28.4]) following the first regular alcohol drinking period, and 27.6 months (CI [25.1, 31.3]) following the first binge drinking episode.

Main Effects

Higher levels of social support were associated with a significantly slowed rate to depression compared to lower levels after alcohol initiation. One unit increases in the social support measure (i.e., SSQ6) were associated with corresponding seven percent decreases in the rate of reaching the CES-D-10 threshold for depression after consuming the first alcoholic drink (HR 0.93 95% CI [0.88, 0.98], p=0.001) and engaging in the first binge drinking episode (HR 0.93, 95% CI [0.87-0.98], p=0.009) (Figure 2). These results indicate that participants with higher levels of social support have a more delayed rate of developing depression after the first drink and first binge drink. However, these effects did not apply for the first regular drinking period (HR 0.97, 95% CI [0.9, 1.04], p=0.355), and they did not hold once controlling for demographics (HR 0.95, 95% CI [0.89, 1], p=0.071) (Table 2).

Covariate Effects

After adjusting for social support effects, men were slower to develop depression (CES-D-10) than women following both alcohol initiation (HR 0.57, 95% CI [0.4, 0.82], p=0.002) and the first binge drinking episode (HR 0.55, 95% CI [0.36, 0.85], p=0.006), even after adjusting for variation due to race, ethnicity, and education. More specifically, one unit increases in the social support measure (i.e., SSQ6) were associated with corresponding 43 and 45 percent decreases in the rate of reaching the CES-D-10 threshold for depression for men compared to women after consuming the first alcoholic drink and engaging in the first binge drinking episode, respectively. In addition, we noticed covariate effects in Hispanic populations and individuals with more educated and more educated parents, although this sample did not have enough power to adequately test these differences (Table 2).

Covariate Moderation Effects

Because the sex differences that we saw could be due to systematic differences in social support in men and women, we mean centered the SSQ6 scores for men and women separately and ran the same analyses for each of the three models. While social support significantly moderated the effect in women after the first drink (HR 0.92, 95% CI [0.87, 0.98], p=0.008), it did not after the first regular drinking period or the regular binge drinking episode (Table 3). Results did not hold after adjusting for covariate effects and were non-significant for men.

Discussion

While social support generally slowed the rate of depression onset after alcohol use initiation, demographic variation (e.g., gender differences) may have stronger utility for predicting naturalistic rates of depression onset. Women experienced a faster time to depression than men after the first drink while social support moderated the effect and, as such, social support interventions might be especially effective for women who begin drinking.

Interpretation

People who initiate alcohol use earlier tend to reach depression more quickly. However, people with higher levels of social support have a delayed onset of depression while those with lower supports are at a significantly higher risk of earlier onset. Therefore, people who have lower levels of social support may benefit from early targeted prevention measures that can be taken in clinical, educational, and policy settings. Using information such as the median time at which people reach depression after drinking (i.e., 20-30 months) and the knowledge that people begin drinking at an average age of 19, public health policies and individualized preventative measures can harness social support to reduce the rate of developing depression after alcohol initiation, particularly in women. Schools and other educational programs – which inherently facilitate social contact – can use this information to inform adolescents and young adults about measures they can take to preventatively protect themselves against depression and may even be able to offer specific social connection programming that mitigates the accumulation of alcohol use problems. As undergraduates have higher rates of binge drinking, college mental health services can also suggest social support preventative measures for people who may be at an increased risk for depression after drinking.

On a more individual level, clinicians could use this information to improve treatment. As results suggest that women are more at risk for experiencing depression after they begin drinking, clinicians should suggest that the client reach out to their support system preventatively. This research sets the stage for early prevention efforts and could provide key insights for tailoring treatment regarding alcohol and depression that can be incorporated in both wide-scale policies and individual settings.

Limitations

While the sample was tracked longitudinally, retrospective reporting techniques used via questionnaires and interviews may have led to unknown biases in estimation of these effects. For example, depression on the CES-D-10 was reported based on experiences in the previous two weeks which may lead to inaccuracies with recall and incomplete coverage of all experiences that occurred in the time lapses between assessments. The power in this sample also limited conclusions that could be made about the effects across demographic groups, although they set the stage for meaningful subsequent studies.

Future Directions & Conclusions

While this study characterizes the effects of social support on the rate of transition from alcohol initiation to depression, studies suggest that alcohol use can also increase after depression is first experienced.[68-70] Thus, analyzing the relationship in the other direction (i.e., rate of transition from depression to alcohol use problems) using well-powered data would allow us to further characterize how social support affects the relationship between depression and alcohol use in a more heterogeneous manner. In addition, assessing this relationship at a momentary level (i.e., daily) would capture intricacies that annual design might miss. Finally, while nationally-representative samples provide key information about these constructs, replicating this study in racially diverse datasets would allow for increased generalizability and more inclusive implications.

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References

1. Binge Drinking. cdc.gov. Published January 6, 2022. Accessed October 25, 2022. https://www.cdc.gov/alcohol/fact-sheets/binge-drinking.htm
2. Underage Drinking. niaaa.nih.gov. Published October 2022. Accessed October 25, 2022.https://www.niaaa.nih.gov/publications/brochures-and-fact-sheets/underage-drinking
3. Major Depression. nimh.nih.gov. Published January 2022. Accessed October 25, 2022. https://www.nimh.nih.gov/health/statistics/major-depression
4. Winerman L. The Cost of Treatment. apa.org. Published March 2017. Accessed October 25, 2022. https://www.apa.org/monitor/2017/03/numbers.
5. Excessive Drinking is Draining the U.S. Economy. cdc.gov. Published April 14, 2022. Accessed October 25, 2022.https://www.cdc.gov/alcohol/features/excessive-drinking.html
6. Depression. who.int. Published September 13, 2021. Accessed October 25, 2022. https://www.who.int/news-room/fact-sheets/detail/depression
7. Alcohol Facts and Statistics. niaaa.nih.gov. Published March 2022. Accessed October 25, 2022. https://www.niaaa.nih.gov/publications/brochures-and-fact-sheets/alcohol-facts-and-statistics
8. Boden JM, Fergusson DM. Alcohol and depression: Alcohol and depression. *Addiction*. 2011;106(5):906-914. doi:10.1111/j.1360-0443.2010.03351.x
9. Bulloch A, Lavorato D, Williams J, Patten S. Alcohol Consumption and Major Depression in the General Population: The Critical Importance of Dependence: Research Article: Alcohol and Depression in the General Population. *Depress Anxiety*. 2012;29(12):1058-1064. doi:10.1002/da.22001
10. Edwards AC, Heron J, Dick DM, et al. Adolescent Alcohol Use Is Positively Associated with Later Depression in a Population-Based U.K. Cohort. *J Stud Alcohol Drugs*. 2014;75(5):758-765. doi:10.15288/jsad.2014.75.758
11. Fergusson DM, Boden JM, Horwood LJ. Tests of Causal Links Between Alcohol Abuse or Dependence and Major Depression. *Arch Gen Psychiatry*. 2009;66(3):260. doi:10.1001/archgenpsychiatry.2008.543
12. Kuria MW, Ndetei DM, Obot IS, et al. The Association between Alcohol Dependence and Depression before and after Treatment for Alcohol Dependence. *ISRN Psychiatry*. 2012;2012:1-6. doi:10.5402/2012/482802
13. McHugh R. Alcohol Use Disorder and Depressive Disorders. *ARCR*. 2019;40(1):arcr.v40.1.01. doi:10.35946/arcr.v40.1.01
14. Common Comorbidities with Substance Use Disorders Research Report. nida.nih.gov. Published April 2020. Accessed October 25, 2022. https://nida.nih.gov/publications/research-reports/common-comorbidities-substance-use-disorders/part-1-connection-between-substance-use-disorders-mental-illness
15. Key Substance Use and Mental Health Indicators in the United States: Results from the 2020 National Survey on Drug Use and Health. samhsa.gov. Published 2020. Accessed October 25, 2022. https://www.samhsa.gov/data/
16. Le TM, Wang W, Zhornitsky S, et al. The Neural Processes Interlinking Social Isolation, Social Support, and Problem Alcohol Use. *International Journal of Neuropsychopharmacology*. 2021;24(4):333-343. doi:10.1093/ijnp/pyaa086

17. Skogen JC, Knudsen AK, Hysing M, Wold B, Sivertsen B. Trajectories of alcohol use and association with symptoms of depression from early to late adolescence: The Norwegian Longitudinal Health Behaviour Study: Trajectories of alcohol use and depression. *Drug Alcohol Rev*. 2016;35(3):307-316. doi:10.1111/dar.12350
18. Foster KT, Hicks BM, Iacono WG, McGue M. Alcohol use disorder in women: Risks and consequences of an adolescent onset and persistent course. *Psychology of Addictive Behaviors*. 2014;28(2):322-335. doi:10.1037/a0035488
19. Foster KT, Hicks BM, Iacono WG, McGue M. Gender differences in the structure of risk for alcohol use disorder in adolescence and young adulthood. *Psychol Med*. 2015;45(14):3047-3058. doi:10.1017/S0033291715001014
20. Foster KT, Hicks BM, Durbin CE, Iacono WG, McGue M. The Gender Risk–Severity Paradox for Alcohol Use Disorder From Adolescence Through Young Adulthood. *Emerging Adulthood*. 2018;6(6):375-386. doi:10.1177/2167696817740453
21. Boersma P, Villarroel MA, Vahratian A. Heavy Drinking Among U.S. Adults, 2018. cdc.gov. https://www.cdc.gov/nchs/products/databriefs/db374.htm. Published August 2020. Accessed October 25, 2022.
22. Delker E, Brown Q, Hasin DS. Alcohol Consumption in Demographic Subpopulations: An Epidemiologic Overview. *Alcohol Res*. 2016;38(1):7-15.
23. Alivernini F, Cavicchiolo E, Girelli L, et al. Relationships between sociocultural factors (gender, immigrant and socioeconomic background), peer relatedness and positive affect in adolescents. Journal of Adolescence. 2019;76(1):99-108. doi:10.1016/j.adolescence.2019.08.011
24. Bailey R, Mokonogho J, Kumar A. Racial and ethnic differences in depression: current perspectives. *NDT*. 2019;Volume 15:603-609. doi:10.2147/NDT.S128584
25. Brody DJ, Pratt LA, Hughes JP. Prevalence of Depression Among Adults Aged 20 and Over: Untied States, 2013-2016. cdc.gov. Published February 2018. Accessed October 25, 2022. https://www.cdc.gov/nchs/products/databriefs/db303.htm.
26. Sarason IG, Sarason BR, Shearin EN, Pierce GR. A Brief Measure of Social Support: Practical and Theoretical Implications. *Journal of Social and Personal Relationships*. 1987;4(4):497-510. doi:10.1177/0265407587044007
27. Coyle C, Bramham J, Dundon N, Moynihan M, Carr A. Exploring the Positive Impact of Peers on Adolescent Substance Misuse. *Journal of Child & Adolescent Substance Abuse*. 2016;25(2):134-143. doi:10.1080/1067828X.2014.896761
28. Gardner M, Steinberg L. Peer Influence on Risk Taking, Risk Preference, and Risky Decision Making in Adolescence and Adulthood: An Experimental Study. Developmental Psychology. 2005;41(4):625-635. doi:10.1037/0012-1649.41.4.625
29. Knoll LJ, Magis-Weinberg L, Speekenbrink M, Blakemore SJ. Social Influence on Risk Perception During Adolescence. Psychol Sci. 2015;26(5):583-592. doi:10.1177/0956797615569578
30. Magis-Weinberg L, Blakemore SJ, Dumontheil I. Social and Nonsocial Relational Reasoning in Adolescence and Adulthood. Journal of Cognitive Neuroscience. 2017;29(10):1739-1754. doi:10.1162/jocn_a_01153
31. Stotsky MT, Bowker JC. An Examination of Reciprocal Associations Between Social Preference, Popularity, and Friendship during Early Adolescence. J Youth Adolescence. 2018;47(9):1830-1841. doi:10.1007/s10964-018-0846-1

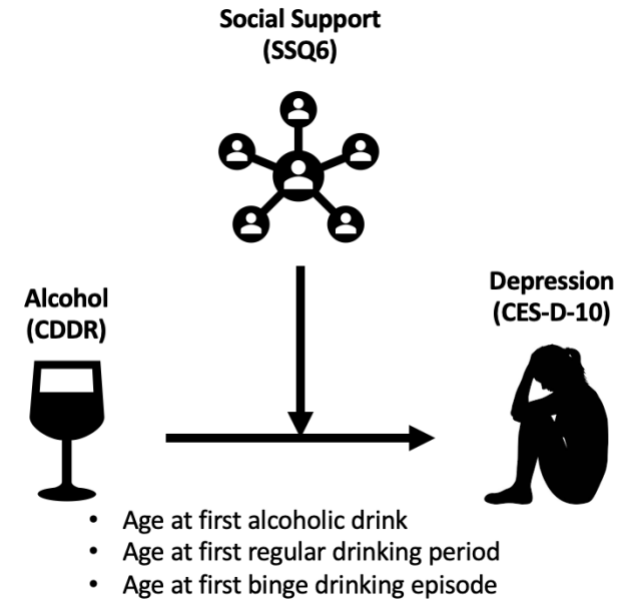
32. Groh DR, Jason LA, Davis MI, Olson BD, Ferrari JR. Friends, Family, and Alcohol Abuse: An Examination of General and Alcohol-Specific Social Support. *Am J Addict*. 2007;16(1):49-55. doi:10.1080/10550490601080084
33. Pedroni C, Dujeu M, Lebacq T, Desnouck V, Holmberg E, Castetbon K. Alcohol consumption in early adolescence: Associations with sociodemographic and psychosocial factors according to gender. Botbol M, ed. *PLoS ONE*. 2021;16(1):e0245597. doi:10.1371/journal.pone.0245597
34. Segrin C, McNelis M, Swiatkowski P. Social Support Indirectly Predicts Problem Drinking Through Reduced Psychological Distress. *Substance Use & Misuse*. 2016;51(5):608-615. doi:10.3109/10826084.2015.1126746
35. Forster M, Grigsby TJ, Gower AL, Mehus CJ, McMorris BJ. The Role of Social Support in the Association between Childhood Adversity and Adolescent Self-injury and Suicide: Findings from a Statewide Sample of High School Students. *J Youth Adolescence*. 2020;49(6):1195-1208. doi:10.1007/s10964-020-01235-9
36. Lezhnieva N, Fredriksen PM, Bekkhus M. Peer relationships and quality of life in 11–12-year-old children: The Health Oriented Pedagogical Project (HOPP). Scand J Public Health. 2018;46(21_suppl):74-81. doi:10.1177/1403494818767788
37. Maunder R, Monks CP. Friendships in middle childhood: Links to peer and school identification, and general self-worth. Br J Dev Psychol. 2019;37(2):211-229. doi:10.1111/bjdp.12268
38. Lyell KM, Coyle S, Malecki CK, Santuzzi AM. Parent and peer social support compensation and internalizing problems in adolescence. *Journal of School Psychology*. 2020;83:25-49. doi:10.1016/j.jsp.2020.08.003
39. Peirce RS, Frone MR, Russell M, Cooper ML, Mudar P. A longitudinal model of social contact, social support, depression, and alcohol use. *Health Psychology*. 2000;19(1):28-38. doi:10.1037/0278-6133.19.1.28
40. Schraedley M.A PK, Gotlib IH, Hayward C. Gender differences in correlates of depressive symptoms in adolescents. *Journal of Adolescent Health*. 1999;25(2):98-108. doi:10.1016/S1054-139X(99)00038-5
41. Nguyen MX, Dowdy D, Latkin CA, et al. Social support modifies the association between hazardous drinking and depression symptoms among ART clients in Vietnam. *Drug and Alcohol Dependence*. 2020;215:108249. doi:10.1016/j.drugalcdep.2020.108249
42. Bokhorst CL, Sumter SR, Westenberg PM. Social Support from Parents, Friends, Classmates, and Teachers in Children and Adolescents Aged 9 to 18 Years: Who Is Perceived as Most Supportive? Social Development. 2010;19(2):417-426. doi:10.1111/j.1467-9507.2009.00540.x
43. De Goede IHA, Branje SJT, Meeus WHJ. Developmental Changes in Adolescents' Perceptions of Relationships with Their Parents. J Youth Adolescence. 2009;38(1):75-88. doi:10.1007/s10964-008-9286-7
44. Furman W, Buhrmester D. Age and Sex Differences in Perceptions of Networks of Personal Relationships. Child Development. 1992;63(1):103. doi:10.2307/1130905
45. Guan SSA, Fuligni AJ. Changes in Parent, Sibling, and Peer Support During the Transition to Young Adulthood. J Res Adolesc. 2016;26(2):286-299. doi:10.1111/jora.12191

46. Scholte RHJ, van Lieshout CFM, van Aken MAG. Perceived Relational Support in Adolescence: Dimensions, Configurations, and Adolescent Adjustment. J Research Adolescence. 2001;11(1):71-94. doi:10.1111/1532-7795.00004
47. Spitz A, Winkler Metzke C, Steinhausen HC. Development of Perceived Familial and Non-familial Support in Adolescence; Findings From a Community-Based Longitudinal Study. Front Psychol. 2020;11:486915. doi:10.3389/fpsyg.2020.486915
48. Dennis JM, Phinney JS, Chuateco LI. The Role of Motivation, Parental Support, and Peer Support in the Academic Success of Ethnic Minority First-Generation College Students. Journal of College Student Development. 2005;46(3):223-236. doi:10.1353/csd.2005.0023
49. Phinney JS, Haas K. The Process of Coping Among Ethnic Minority First-Generation College Freshmen: A Narrative Approach. The Journal of Social Psychology. 2003;143(6):707-726. doi:10.1080/00224540309600426
50. Vaughn AA, Roesch SC. Psychological and Physical Health Correlates of Coping in Minority Adolescents. J Health Psychol. 2003;8(6):671-683. doi:10.1177/13591053030086002
51. Flannery KM, Vannucci A, Ohannessian CM. Using Time-Varying Effect Modeling to Examine Age-Varying Gender Differences in Coping Throughout Adolescence and Emerging Adulthood. *Journal of Adolescent Health*. 2018;62(3):S27-S34. doi:10.1016/j.jadohealth.2017.09.027
52. Frydenberg E, Lewis R. Boys play sport and girls turn to others: age, gender and ethnicity as determinants of coping. *Journal of Adolescence*. 1993;16(3):253-266. doi:10.1006/jado.1993.1024
53. Copeland EP, Hess RS. Differences in Young Adolescents' Coping Strategies Based On Gender and Ethnicity. *The Journal of Early Adolescence*. 1995;15(2):203-219. doi:10.1177/0272431695015002002
54. Taylor SE, Sherman DK, Kim HS, Jarcho J, Takagi K, Dunagan MS. Culture and Social Support: Who Seeks It and Why? *Journal of Personality and Social Psychology*. 2004;87(3):354-362. doi:10.1037/0022-3514.87.3.354
55. Brown SA, Brumback T, Tomlinson K, et al. The National Consortium on Alcohol and NeuroDevelopment in Adolescence (NCANDA): A Multisite Study of Adolescent Development and Substance Use. *J Stud Alcohol Drugs*. 2015;76(6):895-908. doi:10.15288/jsad.2015.76.895
56. Hamdi NR, Iacono WG. Lifetime prevalence and co-morbidity of externalizing disorders and depression in prospective assessment. *Psychol Med*. 2014;44(2):315-324. doi:10.1017/S0033291713000627
57. Brown SA, Myers MG, Lippke L, Tapert SF, Stewart DG, Vik PW. Psychometric evaluation of the Customary Drinking and Drug Use Record (CDDR): a measure of adolescent alcohol and drug involvement. *J Stud Alcohol*. 1998;59(4):427-438. doi:10.15288/jsa.1998.59.427
58. Andresen EM, Malmgren JA, Carter WB, Patrick DL. Screening for depression in well older adults: evaluation of a short form of the CES-D (Center for Epidemiologic Studies Depression Scale). *Am J Prev Med*. 1994;10(2):77-84.
59. Radloff LS. The use of the Center for Epidemiologic Studies Depression Scale in adolescents and young adults. *J Youth Adolescence*. 1991;20(2):149-166. doi:10.1007/BF01537606

60. Radloff LS. The CES-D Scale: A Self-Report Depression Scale for Research in the General Population. *Applied Psychological Measurement*. 1977;1(3):385-401. doi:10.1177/014662167700100306
61. Björgvinsson T, Kertz SJ, Bigda-Peyton JS, McCoy KL, Aderka IM. Psychometric Properties of the CES-D-10 in a Psychiatric Sample. *Assessment*. 2013;20(4):429-436. doi:10.1177/1073191113481998
62. Singer JD, Willett JB. It's about Time: Using Discrete-Time Survival Analysis to Study Duration and the Timing of Events. *Journal of Educational Statistics*. 1993;18(2):155. doi:10.2307/1165085
63. Carroll OU, Morris TP, Keogh RH. How are missing data in covariates handled in observational time-to-event studies in oncology? A systematic review. *BMC Med Res Methodol*. 2020;20(1):134. doi:10.1186/s12874-020-01018-7
64. Haensch AC, Weiß B. *Multiple Imputation of Partially Observed Covariates in Discrete-Time Survival Analysis*. SocArXiv; 2020. doi:10.31235/osf.io/ptwvq
65. Huque MH, Carlin JB, Simpson JA, Lee KJ. A comparison of multiple imputation methods for missing data in longitudinal studies. *BMC Med Res Methodol*. 2018;18(1):168. doi:10.1186/s12874-018-0615-6
66. Karahalios A, Baglietto L, Lee KJ, English DR, Carlin JB, Simpson JA. The impact of missing data on analyses of a time-dependent exposure in a longitudinal cohort: a simulation study. *Emerg Themes Epidemiol*. 2013;10(1):6. doi:10.1186/1742-7622-10-6
67. van Buuren S. Multiple imputation of discrete and continuous data by fully conditional specification. *Stat Methods Med Res*. 2007;16(3):219-242. doi:10.1177/0962280206074463
68. Birrell L, Slade T, Teesson M, et al. Bidirectional relationships in the development of internalising symptoms and alcohol use in adolescence. *Drug Alcohol Rev*. 2020;39(7):950-959. doi:10.1111/dar.13070
69. Crum RM, Green KM, Storr CL, et al. Depressed Mood in Childhood and Subsequent Alcohol Use Through Adolescence and Young Adulthood. *Arch Gen Psychiatry*. 2008;65(6):702. doi:10.1001/archpsyc.65.6.702
70. Edwards AC, Joinson C, Dick DM, et al. The association between depressive symptoms from early to late adolescence and later use and harmful use of alcohol. *Eur Child Adolesc Psychiatry*. 2014;23(12):1219-1230. doi:10.1007/s00787-014-0600-5

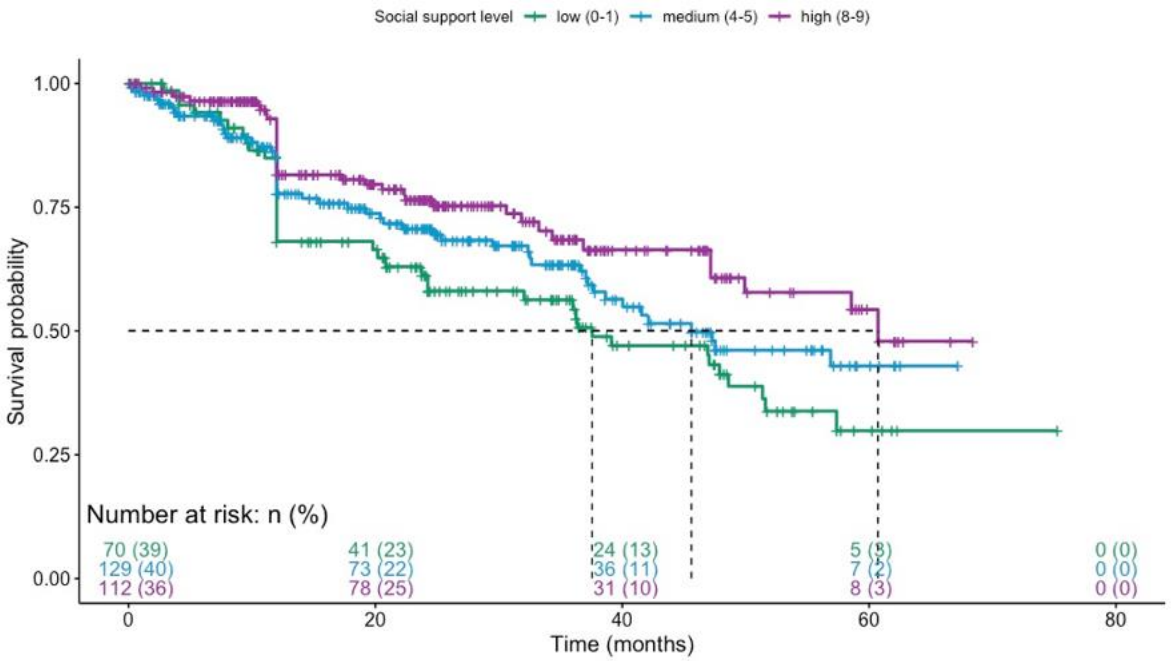
Figures

Figure 1: Moderation Model



Each model tested the impact of social support on the time between first alcohol use (first drink, regular drinking period, binge drinking episode) and first depression (CES-D-10 score of 10 or greater).

Figure 2: Effect of Social Support on Risk of Depression after First Drink



Participants with higher levels of social support have a slower rate to the first CES-D-10 threshold than those with lower levels of social support. A one-unit increase in the SSQ6 measurement is associated with a 7% decreased rate of developing depression. The dashed line represents the median survival time for each level of social support (i.e.,

low, medium, high). *The figure above uses three sub-categories of the SSQ6 for visualization purposes only; models were calculated using the raw, continuous SSQ6 scores.

Tables

Table 1: Sample Characteristics of Analyzed Participants.

	Model1[+] **N*(%)***	**Model2**[+] **N(%)**	**Model3**[+] **N(%)**
Male	254*(49.9)*	114*(55.6)*	180*(52.5)*
Female	255*(50.1)*	91*(44.4)*	163*(47.5)*
Native American/American Indian	0*(0)*	0*(0)*	0*(0)*
Asian	33*(6.5)*	13*(6.3)*	22*(6.4)*
Pacific Islander	3*(0.6)*	1*(0.5)*	2*(0.6)*
Hispanic or Latino	63*(12.4)*	18*(8.8)*	37*(10.8)*
African American/Black	43*(8.4)*	18*(8.8)*	28*(8.2)*
Caucasian/White	389*(76.4)*	164*(80)*	269*(78.4)*
Other	41*(8.1)*	9*(4.4)*	22*(6.4)*
Censored	224*(44)*	87*(42.4)*	138*(40.2)*
	M (SD)	**M (SD)**	**M (SD)**
Baseline Parent SES	16.29 (2.46)	16.63 (2.36)	16.56 (2.31)

Youth SES	12.87 (1.33)	12.93 (1.18)	12.86 (1.21)
Baseline Age	16.98 (2.36)	17.78 (2.12)	17.28 (2.23)

This table describes sample characteristics for eligible participants who were included in the analysis. [+]Model1 = first drink to first CES-D-10 threshold; Model2 = first regular drinking period to first CES-D-10 threshold; Model3 = first binge drinking episode to first CES-D-10 threshold.

Table 2: Moderation Results.

	Base Model SSQ6 Score HR (%Δ) [95% CI] (p-value)	**Complex Model SSQ6 Score** HR (%Δ) [95% CI] (p-value)	**Sex** HR (%Δ) [95% CI] (p-value)	**Race** HR (%Δ) [95% CI] (p-value)	**Ethnicity** HR (%Δ) [95% CI] (p-value)	**Parent SES** HR (%Δ) [95% CI] (p-value)	**Participant SES** HR (%Δ) [95% CI] (p-value)
1[+]	0.93 (-7%) [0.88, 0.97] **(p=0.001)***	0.95 (-5%) [0.89, 1] (p=0.071)	0.57 (-43%) [0.40, 0.82] **(p=0.002)***	0.93 (-7%) [0.77, 1.13] (p=0.471)	2.97 (+197%) [1.88, 4.67] **(p<0.001)***	0.96 (-4%) [0.89, 1.03] (p=0.288)	0.79 (-21%) [0.70, 0.89] **(p<0.001)***
2[+]	0.97 (-3%) [0.90, 1.04] (p=0.355)	0.98 (-2%) [0.90, 1.07] (p=0.671)	0.74 (-26%) [0.45, 1.23] (p=0.240)	0.96 (-4%) [0.71, 1.31] (p=0.811)	3.45 (+245%) [1.71, 6.99] **(p<0.001)***	0.92 (-8%) [0.82, 1.02] (p=0.097)	0.82 (-18%) [0.69, 0.98] (p=0.026)
3[+]	0.93 (-7%) [0.87, 0.98] **(p=0.009)***	0.95 (-5%) [0.89, 1.02] (p=0.171)	0.55 (-45%) [0.36, 0.85] **(p=0.006)***	0.93 (-7%) [0.75, 1.16] (p=0.515)	3.30 (+230%) [1.98, 5.52] **(p<0.001)***	0.88 (-12%) [0.81, 0.97] **(p=0.007)***	0.76 (-24%) [0.66, 0.88] **(p<0.001)***

*=p<0.017; HR=hazard ratio. %Δ=percent decrease or increase in the outcome. [+]Model1 = first drink to first CES-D-10 threshold; Model2 = first regular drinking period to first CES-D-10 threshold; Model3 = first binge drinking episode to first CES-D-10 threshold. The base model measures the effect of SSQ6 only, while the complex model includes each demographic covariate listed in the table.

Table 3: Mean Centered Results.

	Base Model SSQ6 Score HR (%Δ) [95% CI] (p-value)	**Complex Model SSQ6 Score** HR (%Δ) [95% CI] (p-value)	**Race** HR (%Δ) [95% CI] (p-value)	**Ethnicity** HR (%Δ) [95% CI] (p-value)	**Parent SES** HR (%Δ) [95% CI] (p-value)	**Participant SES** HR (%Δ) [95% CI] (p-value)
1^{+} Female	0.92 (-8%) [0.87, 0.98] **(p=0.008)***	0.94 (-6%) [0.87, 1.01] (p=0.108)	0.91 (-9%) [0.71, 1.16] (p=0.436)	3.09 (+209%) [1.49, 6.39] **(p=0.003)***	0.94 (-6%) [0.85, 1.04] (p=0.221)	0.72 (-28%) [0.62,0.85] **(p<0.001)***
1^{+} Male	0.93 (-7%) [0.86, 1.00] (p=0.041)	0.97 (-3%) [0.88, 1.06] (p=0.460)	0.98 (-2%) [0.70, 1.37] (p=0.900)	2.75 (+175%) [1.50, 5.05] **(p=0.002)***	0.98 (-2%) [0.88, 1.09] (p=0.662)	0.91 (-9%) [0.76, 1.10] (p=0.338)
2^{+} Female	0.94 (-6%) [0.85, 1.04] (p=0.246)	1.00 (+0%) [0.89, 1.13] (p=0.951)	0.82 (-18%) [0.56, 1.19] (p=0.277)	3.41 (+241%) [0.85, 13.69] (p=0.082)	0.86 (-14%) [0.73, 1.02] (p=0.079)	0.76 (-24%) [0.60, 0.95] (p=0.019)
2^{+} Male	0.99 (-1%) [0.89, 1.10] (p=0.841)	0.99 (-1%) [0.87, 1.12] (p=0.938)	1.47 (+47%) [0.71, 3.04] (p=0.287)	3.48 (+248%) [1.47, 8.25] **(p=0.006)***	0.95 (-5%) [0.82, 1.11] (p=0.523)	0.90 (-10%) [0.67, 1.23] (p=0.499)
3^{+} Female	0.92 (-8%) [0.85, 1.00] (p=0.042)	0.94 (-6%) [0.85, 1.03] (p=0.152)	0.89 (-11%) [0.67, 1.20] (p=0.438)	2.62 (+162%) [1.02, 6.70] (p=0.045)	0.84 (-16%) [0.74, 0.96] **(p=0.014)***	0.64 (-36%) [0.52, 0.77] **(p<0.001)***
3^{+} Male	0.92 (-8%) [0.84, 1.08] (p=0.074)	0.97 (-3%) [0.87, 1.08] (p=0.582)	0.98 (-2%) [0.67, 1.43] (p=0.910)	3.79 (+279%) [1.93, 7.41] **(p<0.001)***	0.91 (-9%) [0.80, 1.04] (p=0.149)	0.90 (-10%) [0.72, 1.11] (p=0.323)

*=p<0.017; HR=hazard ratio. %Δ=percent decrease or increase in the outcome. $^{+}$Model1 = first drink to first CES-D-10 threshold; Model2 = first regular drinking period to first CES-D-10 threshold; Model3 = first binge drinking episode to first CES-D-10 threshold. The SSQ6 score was mean centered in men and women separately for each model. The base model measures the effect of SSQ6 only, while the complex model includes each demographic covariate listed in the table.