



Published in final edited form as:

*Drug Alcohol Depend.* 2020 July 01; 212: 108068. doi:10.1016/j.drugalcdep.2020.108068.

## Within- and between-person associations of neighborhood poverty with alcohol use and consequences: A monthly study of young adults

Isaac C. Rhew<sup>a,\*</sup>, Jennifer C. Duckworth<sup>a</sup>, Philip M. Hurvitz<sup>b,c</sup>, Christine M. Lee<sup>a</sup>

<sup>a</sup>Department of Psychiatry and Behavioral Sciences, University of Washington, Center for the Study of Health and Risk Behaviors, 1100 NE 45<sup>th</sup> St., #300, Seattle, WA 98105, USA

<sup>b</sup>Center for Studies in Demography and Ecology, University of Washington, 218 L Raitt Hall, Box 353412, Seattle, WA 98195 USA

<sup>c</sup>College of Built Environments, University of Washington, Urban Form Lab, 1107 NE 45<sup>th</sup> St., #535, Seattle, WA 98105, USA

### Abstract

**Background:** Studies have shown associations between neighborhood disadvantage and alcohol misuse among adults. Less is known about the role of neighborhood context in young adults (YAs), who engage in more disordered forms of alcohol use compared to other age groups. Using data collected monthly, this study examined whether YAs reported more alcohol use and consequences when they were living in neighborhoods with greater concentration of poverty.

**Method:** This study used data from 746 participants aged 18-23 years living in the Seattle, WA, region. Surveys were administered each month for 24 consecutive months. Measures included typical number of drinks per week and past month count of alcohol-related consequences. Residential addresses at each month were geocoded and linked to census-tract level percentage of households living at or below poverty threshold. Multilevel over-dispersed Poisson models were used to estimate associations between standardized monthly deviations in tract-level poverty from one's average and alcohol outcomes.

**Results:** Across 14,247 monthly observations, the mean number of typical drinks per week was 4.8 (SD = 7.4) and the mean number of alcohol consequences was 2.1 (SD = 3.5). On months when they were living in neighborhoods with higher levels of poverty than their average, participants reported significantly higher levels of alcohol consequences (Count Ratio = 1.05;  $p = .045$ ).

\*Corresponding Author: (ICR) rhew@uw.edu.

**Contributors.** All authors contributed to the interpretation of the results and writing and editing of this manuscript. Dr. Rhew conceived of the research question for this manuscript and led analyses. Dr. Duckworth led the literature review. Dr. Hurvitz conducted the geocoding and creation of neighborhood measures. Dr. Lee was responsible for acquiring funding and overseeing the data collection for the parent study.

**Publisher's Disclaimer:** This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

**Conflict of Interest.** No conflict declared.

**Conclusion:** YAs may engage in more problematic forms of drinking when they reside in neighborhoods with higher levels of disadvantage. During a time of frequent residential changes, YAs moving to more disadvantaged neighborhoods may benefit from additional supports.

## Keywords

neighborhood context; alcohol; young adulthood; poverty

---

## 1. Introduction

Young adults, typically defined as individuals aged 18-25, are more likely to use alcohol and to experience alcohol-related consequences than other age groups (Hingson et al., 2017; Schulenberg et al., 2018; Schulenberg, and Maggs, 2002). Although alcohol use in young adulthood is normative and may facilitate important developmental tasks such as identity exploration, autonomy development, and the achievement of social goals (Arnett, 2005; Schulenberg, and Maggs, 2002), alcohol use, and especially heavy alcohol use, is also related to many negative outcomes, including emergency department visits (Elder et al., 2004; White et al., 2018), traffic-related injuries and fatalities and other unintentional injuries (Hingson et al., 2017), and cognitive impairments (Carbia et al., 2017). Young adults also have a higher prevalence of alcohol use disorder than any other age group (Grant et al., 2015). As such, identifying risk factors for patterns of heavy alcohol use is a public health concern. While most of the work investigating the etiology of high-risk alcohol use has focused on individual-level factors, there is emerging research that suggests that ecological-level contexts, more specifically residential neighborhoods, may influence risk among adults.

Although not entirely consistent, the extant literature points to a potential role of neighborhood-level poverty and socioeconomic disadvantage on excessive alcohol use (e.g., Brenner et al., 2015; Cerdá et al., 2010; Duncan et al., 2002; Karriker-Jaffe et al., 2012; McKinney, et al., 2012; Rhew et al., 2018). For example, Cerdá and colleagues (2010) found that individuals with greater exposure to residential neighborhoods with high levels of poverty showed a greater subsequent frequency of alcohol consumption and likelihood of heavy episodic drinking. As described by social disorganization theory (Sampson and Groves, 1989), impoverished neighborhoods may lack the material and social resources to maintain prosocial bonds and social cohesion among residents, which could lead to a lack of informal social control and disorganization and more permissive norms around alcohol and other substance use. Further, disadvantaged and disorganized neighborhoods may have higher levels of psychosocial stressors (e.g., crime, physical disorder) and lack psychosocial resources that may lead to use of alcohol or other substances as a coping strategy.

Most studies of neighborhood context and alcohol use, and health more broadly, have been cross-sectional (Arcaya et al., 2016). Further, of the extant longitudinal studies, most have assessed the between-person association between a neighborhood variable ascertained at one time point and an outcome at a subsequent time point, typically a year or more later (e.g., Martin- Storey et al., 2013). During young adulthood, a developmental period often marked by frequent residential changes, it would be of particular interest to investigate finer

temporal scales to assess whether an individual's alcohol use and consequences vary with their concurrent levels of neighborhood disadvantage. Longitudinal design studies with frequent assessments of the neighborhood exposure and the outcomes could allow researchers to explore this question by estimating *within*-person associations that describe whether living in a neighborhood with higher levels of disadvantage compared to one's own average level of neighborhood disadvantage over time is associated alcohol use and consequences. Such within-person approaches also offer a complementary method to improve causal inference for neighborhood effects research by accounting for person-level measured and unmeasured factors that could bias results (Jokela, 2015).

This study took advantage of a unique longitudinal study that surveyed young adults, aged 18 to 23 years at baseline, monthly for 24 consecutive months. This allowed us to assess whether typical drinking and alcohol-related consequences were higher on months when individuals were living in neighborhoods of greater poverty than their average across all months during the study period. Because of prior studies that suggested that the role of neighborhood factors in alcohol use may vary by sex (Ahern et al., 2008; Karriker-Jaffe et al., 2012; Matheson et al., 2012) and because of the important social context of 4-year college (Barnes et al., 2010; Dawson et al., 2004; Slutske, 2005) as well as whether the young adult lives with parents (Gfoerer et al., 1997), we also explored moderation of within-person associations by sex, college attendance, and living with parents.

## 2. Materials and methods

### 2.1. Participants and Design

A community sample was recruited for this longitudinal study. Young adults in the broader Seattle, Washington metropolitan area were recruited via online and social media advertising (e.g., Craigslist, Facebook), flyering, advertisements in local and school newspapers, and other outreach activities (see Patrick et al., 2018 for additional details). All recruitment materials had the study contact phone number and a link to access the study website. Interested individuals were asked to complete a brief online eligibility survey. Initial eligibility criteria for the study included residing within the greater Seattle metropolitan area (i.e., 60 miles from study offices), having a valid email address, reporting drinking alcohol at least once in the last year, and being willing to come to the study office for an initial appointment. We had 779 young adults meet eligibility criteria, schedule and complete their initial appointment and baseline survey (out of 1,644 eligible, most not completing baseline survey was due to incompatibility of scheduling in-person appointment). During the 1.5-2 hour in-person appointment at the research study site, young adults completed age verification and informed consent with study staff and then completed on their own a baseline assessment on study computers. For the next consecutive 24 months, beginning the 1<sup>st</sup> day of the month, participants were invited to complete an online monthly survey about social role transitions and alcohol use during the previous month. We had excellent retention throughout the two years of data collection, with monthly completion rates ranging from 78.4% to 97.7%. Participants were compensated \$40 in Amazon gift cards for the baseline assessment and between \$20 and \$45 for monthly surveys depending on survey length. The study had university Institutional Review Board approval and no adverse events occurred.

## 2.2. Measures

**2.2.1. Neighborhood poverty.**—As part of the study, participants were asked each month to report their current residential address. These addresses were geocoded and then linked to the census tract where the residence was located. Geocoding was performed using ArcGIS Desktop 10.6.1 (ESRI, 2014) using King County E-911 address points as the reference data set. Minimum match score was set to 100, and any addresses not matching automatically were reviewed interactively and matched where possible using other sources such as Google Maps. The proportion of residents within each participant’s census tract living at or below poverty was obtained from the American Community Survey using a five-year average. This measure has been widely used as an indicator of neighborhood socioeconomic conditions in epidemiologic research and has been linked to heavy alcohol use and related problems in multiple studies (e.g., Cerdá et al., 2010; McKinney et al., 2012).

**2.2.2. Alcohol use and consequences.**—Total drinks per week was assessed using a modified Daily Drinking Questionnaire (Collins et al., 1985). Each month participants were asked, “Consider a typical week during the last three months. How much alcohol (measured in number of standard drinks), on average, do you drink each day of a typical week?” The total number of drinks in a typical week was calculated as a sum score. For analyses, we recoded the maximum possible value to 50. Alcohol-related consequences were assessed with the Brief Young Adult Alcohol Consequences Questionnaire (BYAACQ; Kahler et al., 2005). This measure consists of self-ratings of 24 possible alcohol-related consequences. For each of the items, participants indicated whether or not they experienced the consequence in the previous 30 days. The sum of the responses was calculated to represent the count of past month consequences.

**2.2.3 Demographics.**—We obtained demographic information at baseline, including age, biological sex, sexual orientation, race, Hispanic ethnicity, and parents’ highest level of education. At baseline, participants were also asked to report whether they experienced any financial difficulties in the past 12 months in six categories (cash-flow difficulties, saving money, inability to do things they wanted to do due to lack of money, inability to pay bills, trying to secure a loan, other). The sum of the financial items was calculated as a measure of financial distress (0 to 6). At each month, participants reported whether or not they were currently attending a 4-year college, were living at their parent’s homes, and had a residential move in the prior month.

## 2.3. Data Analytic Plan

To examine associations between neighborhood-level poverty and alcohol outcomes, we used generalized mixed effects models (GLMMs) with maximum likelihood estimation to account for the clustering of repeated observations within individuals over the 24-month study and a separate clustering of individuals within census tracts within any given month. A random intercept was specified for each individual and census tract. To disaggregate between- and within-person effects, we included two covariates for neighborhood poverty (Curran, and Bauer, 2011). The first was a time-fixed (Level 2) covariate for the mean level of neighborhood poverty across all available months of data for a given person,

$i(\overline{neighborhood\ poverty}_i)$ . The second was a time-varying (Level 1) covariate for the deviation between one's neighborhood poverty at month  $j$  from their average neighborhood poverty across all months ( $neighborhood\ poverty_{ij} - \overline{neighborhood\ poverty}_i$ ). To assist with interpretation, we standardized both neighborhood poverty covariates such that each had a mean of 0 and standard deviation of 1.

We further included time-fixed covariates for sex (0: female; 1: male), sexual orientation (0: heterosexual; 1: non-heterosexual), dummy codes for race (white [referent group], Asian, other), Hispanic ethnicity, highest level of education completed by parents (0: less than undergraduate degree; 1: Bachelor's degree or more), age at baseline in years, and baseline financial difficulties; and time-varying covariates for duration since baseline (in years, for ease of interpretation), 4-year college attendance, living with parents, and residential move in the past month.

The monthly outcomes in the analyses were the typical number of drinks per week and the number of alcohol-related consequences. Both variables were discrete non-negative integers showing a positive skew. Further, because both variables showed over-dispersion, with the variance exceeding the mean, an over-dispersed Poisson version of the GLMM was used. Count ratios (CRs; also referred to as rate ratios) were estimated to describe the proportional change in the outcome associated with a 1-unit increase in the covariate conditional on random effects (Atkins et al., 2013). In separate models, we also examined whether sex and four-year college status and living with parents that month moderated the association between within-person neighborhood poverty and the alcohol outcomes by including interaction terms (e.g., monthly-deviation-in-neighborhood-poverty-x-college-status).

In this study sample, 45.3% of participants lived in one census tract during the study period. In primary analyses, all participants were included. As sensitivity analyses we excluded those participants living in only one census tract.

As mentioned above, there were missing data over the course of the study with response rates for the monthly surveys ranging from 78.4% to 97.7%. The mean number of monthly surveys completed out of a possible 24 was 19.1 and the median was 22 (range: 1 to 24). GLMMs utilize all available data and should yield unbiased estimates in the presence of missing data assuming that data were missing at random; that is, missingness was only related to measured variables (Atkins, 2005; Diggle et al., 2002).

All analyses were conducted using R statistical software version 3.5 (Team, 2013) and the "lme4" package (Bates et al., 2014) was used to run the GLMMs.

### 3. Results

Analyses included 14,247 data from among 746 participants with at least one month of alcohol outcome data and non-missing baseline covariate data. There were a total of 578 unique census tracts represented. Table 1 shows characteristics of the study sample. Of note, the mean percentage of months that participants were attending 4-year college during the course of the study was 37.6% (SD = 41.1; range: 0, 100). The percentage of participants

attending 4-year college at any time during the study was 58.5%. On average, participants lived with their parents on 32.3% of months during the study (SD = 36.0; range: 0, 100) and 66.6% lived with their parents at some point during the study.

The mean number of typical drinks per week across all observations was 4.8 (SD = 7.4; range: 0, 50) and the mean number of alcohol-related consequences was 2.1 (SD = 3.5; range: 0, 24). There was substantial within-person variability in the alcohol outcomes with an average within-person SD of 3.4 for typical drinking and 1.8 for alcohol consequences.

In the census tracts represented, the average percentage of residents living at or below poverty within the tract was 18.3 (SD = 16.4; range: 0, 64.7). The average number of census tracts in which an individual resided across the course of the study was 1.8. Although the majority of variance in neighborhood poverty was between-person, there was still substantial within-person variance (ICC = 0.74). Before standardization for statistical models, the SD of the person-mean (Level 2) of neighborhood poverty was 14.1 and the average SD of the within-person (Level 1) monthly deviation in neighborhood poverty from one's average was 8.3.

Table 2 shows results from the GLMMs for the association of neighborhood poverty and other covariates with the typical drinking. There was a statistically significant *between*-person association such that, for a given level of random effects, a 1-SD (14.1%) increase in average neighborhood poverty concentration over the course of the study was associated with a 23% increase in the count of typical drinks consumed per week (CR = 1.23; 95% CI: 1.07, 1.41;  $p = 0.003$ ). Although young adults consumed more alcohol in months when they lived in neighborhoods with higher levels of poverty than their average, this *within*-person association was not statistically significant (CR = 1.04; 95% CI: 0.99, 1.10;  $p = 0.120$ ). For other time-fixed covariates, we found significantly higher levels of typical drinking Whites compared to Asians and among heterosexual compared to non-heterosexual participants. In terms of other time-varying covariates, typical drinking tended to decline over the course of the study and was higher during months when an individual reported being in 4-year college and if they reported a move that month. However, typical drinking was lower when living with parents. When examining moderation, the association between neighborhood poverty and typical drinking varied according to whether the participant was living with one's parents (interaction- $b = 0.07$ ;  $p = 0.008$ ). Monthly deviations in neighborhood poverty were significantly associated with greater typical drinking when living with parents (CR = 1.09;  $p = 0.006$ ), but not when living away from parents (CR = 1.02;  $p = 0.368$ ). There were no statistically significant interactions of monthly neighborhood poverty with sex (interaction- $b = 0.03$ ;  $p = 0.177$ ) nor college status (interaction- $b = 0.02$ ;  $p = 0.453$ ).

There were both between- and within-person associations of neighborhood poverty with alcohol-related consequences (Table 3). Individuals who on average resided in more impoverished neighborhoods reported a greater number of consequences (CR = 1.27; 95% CI: 1.10, 1.46;  $p = 0.001$ ). Further, on months when they lived in neighborhoods with a 1 SD higher deviation in neighborhood poverty than their overall average, individuals reported 5% more consequences (CR = 1.05; 95% CI: 1.00, 1.11;  $p = 0.045$ ). In regards to other covariates, more consequences were reported among heterosexual compared to non-



heterosexual participants, Whites compared to Asians, and those reporting greater financial difficulties at baseline. Finally, there were higher levels of consequences during months when the participant reported attending 4-year college, but lower levels of consequences as the study progressed and when living with parents. There was no statistically significant moderation of associations by sex (interaction- $b = -0.03$ ;  $p = 0.244$ ), 4-year college attendance (interaction- $b = 0.04$ ;  $p = 0.104$ ), nor living with parents (interaction- $b = 0.01$ ;  $p = 0.638$ ).

Sensitivity analyses restricted models to 7,789 monthly observations from 396 participants who resided in at least two different census tracts over the course of the study. For typical drinking, the associations became somewhat attenuated and were no longer statistically significant for both the between-person (CR = 1.16; 95% CI: 0.96, 1.39;  $p = 0.119$ ) and within-person associations (CR = 1.02; 95% CI: 0.96, 1.07;  $p = 0.600$ ). The findings for alcohol consequences, however, remained nearly identical in magnitude compared to the original results for the between-person (CR = 1.31; 95% CI: 1.08, 1.59;  $p = 0.006$ ) and within-person (CR = 1.05; 95% CI: 1.00, 1.11;  $p = 0.069$ ) associations.

#### 4. Discussion

In this study that followed young adults monthly for 24 consecutive months, we found both between- and within-person associations between neighborhood poverty and alcohol use and consequences. Individuals who lived in more disadvantaged neighborhoods over the course of the study on average tended to report higher levels of typical drinking and alcohol-related consequences on any given month. This between-person association may be at least partially due to effects of exposure to greater levels of neighborhood poverty, but another explanation is that individuals who are more prone to live in disadvantaged neighborhoods for whatever reason may be more likely to use alcohol and experience consequences. However, when examining within-person associations that reduce potential biases due to unmeasured person-level factors, individuals reported higher levels of negative alcohol-related consequences during months when they resided in neighborhoods with higher levels of poverty than their average, pointing to possible independent environmental effects. Although not reaching statistical significance, the within-person association for typical drinking was of similar magnitude as the association for alcohol consequences.

These results are consistent with previous cross-sectional and longitudinal studies showing associations between neighborhood disadvantage and heavier alcohol consumption and more problematic forms of use (Cerdá et al., 2010; Rhew et al., 2018). The current study findings are notable in that they capture month-to-month temporal changes in alcohol outcomes and neighborhood context within a relatively short period (two years). The impact of neighborhood disadvantage on alcohol behaviors, then, may be quickly embodied by young adults. This sensitivity to neighborhood disadvantage for young adults may be amplified due to increased individual psychosocial stresses during a developmental period of multiple social role transitions and pressures. A lack of material and psychosocial resources within one's neighborhood that could buffer against one's own experience of psychosocial stress may be particularly felt by young adults and cause them to use alcohol as a method to cope with stress. Future research should explore this and other potential mechanisms such as the

influence of neighborhood norms around permissibility of excessive alcohol use as well as the potential interplay of additional measurable neighborhood factors towards alcohol misuse in young adults (Rhew et al., 2017).

If replicated in future research, these study findings may have important public health implications. During this time of residential mobility, young adults moving to more disadvantaged neighborhoods may benefit from additional supports. For example, there has been increasing interest in adaptive interventions that consider changes in individuals' experiences, circumstances, and environments as they occur (Chaix, 2018; Nahum-Shani et al., 2017). It may be useful to incorporate individuals' residential changes, particularly moves to more disadvantaged neighborhoods, into such types of interventions. Further, although this study focused on within-person associations and may have more direct implications for person-level interventions, this work may also suggest the need for neighborhood-level strategies that address modifiable macro-environmental factors. For example, there may be modifiable neighborhood contextual factors that often arise in disadvantaged areas that could be targets of intervention such as norms around excessive alcohol use (Ahern et al, 2008) or social disorganization (Cambron et al., 2017; Winstanley et al., 2008).

This study had a number of important strengths. We were able to take advantage of a rich study with intensive longitudinal data collection consisting of monthly assessments over 24 consecutive months during a life period including important developments in social transitions and health behaviors. This allowed us to look at month-to-month temporal within-person changes with a reduced risk of recall bias given that participants needed to only consider their past month's behaviors and statuses. Further, we were able to geocode participants' residential addresses at each month and link them to an objective measure of neighborhood disadvantage, which removed same-source bias (Diez-Roux, 2007).

However, the study should also be considered in light of important limitations. This study was recruited from a specific urban region in the Pacific Northwest and results may not be generalizable to young adults across other geographic contexts. Relatedly, the study sample was restricted in terms of racial diversity. Although research has documented racial/ethnic heterogeneity in the association between neighborhood socioeconomic conditions and alcohol use (Karriker-Jaffe et al., 2012), we were not adequately powered to fully examine this in our study sample. The recruitment methods used for this study sample involved social media and other online forms of advertisements. Thus, this sample may not necessarily be representative of the young adult population in the region. However, this recruitment strategy allowed us to approach an otherwise hard-to-reach population of young adults that has been difficult to recruit into research studies via traditional methods such as random digit dialing. Further, because this study was focused on the association between variables of interest (notably at the within-person level) and not on providing descriptive epidemiologic prevalence estimates, obtaining a truly representative sample may not be necessary (Rothman et al., 2013). Another limitation was that an administrative boundary, census tract, was used to define neighborhood in this study. Given their variability in size and the potential heterogeneity of spatial clusters of poverty within a census tract, this and other forms of administrative geographic units may not represent the lived neighborhood of



exposure and experience. However, we would expect the measurement error for neighborhood disadvantage to be non-differential with respect to the alcohol outcomes and thus results would be conservative. Finally, although we were able to adjust for multiple time-varying and time-fixed covariates, it is possible that there may be residual confounding or confounding due to other unmeasured factors that may account for the observed associations.

Young adulthood is an important developmental period that involves multiple social transitions (Arnett, 2000), including increased residential mobility. This study found that individuals navigating this developmental period showed greater levels of alcohol-related consequences when they were living in areas with greater levels of poverty. Thus, in addition to the risks posed by stresses related to role transitions (Bachman et al., 2013; Cadigan et al., 2019), young adults may be more vulnerable to hazardous alcohol use when living in more disadvantaged areas. Further research using more diverse study samples with additional measures of neighborhood features may bring more clarity to how neighborhood contexts shape alcohol use. In addition, there may be environmental factors outside of one's neighborhood of residence that could influence young adults' alcohol use. Future research that integrates global positioning system (GPS) with ecological momentary assessment (EMA) methods could uncover geospatial factors across young adults' activity spaces that influence hazardous alcohol use at even finer spatial and temporal scales to inform novel intervention approaches (Freisthler et al., 2014; Mair et al., 2019; Stahler et al., 2013).

## Acknowledgements.

The authors are grateful to Devon Alisa Abdallah for her assistance with data management and documentation of study procedures.

**Role of Funding Source.** This study was supported by a grant from the National Institute on Alcohol Abuse and Alcoholism (R01AA022087, PI: Christine Lee) and a pilot grant from the University of Washington Department of Psychiatry and Behavioral Sciences (PI: Isaac Rhew). The funders did not play any role in the design, data collection, analyses, interpretation of results, or manuscript preparation for this study. The content of this paper is solely the responsibility of the authors and does not necessarily reflect the official views of the funding agencies.

## References

- Ahern J, Galea S, Hubbard A, Midanik L, Syme SL, 2008 "Culture of drinking" and individual problems with alcohol use. *Am. J. Epidemiol*, 167, 1041–1049. 10.1093/aje/kwn022. [PubMed: 18310621]
- Arcaya MC, Tucker-Seeley RD, Kim R, Schnake-Mahl A, So M, Subramanian S, 2016 Research on neighborhood effects on health in the United States: A systematic review of study characteristics. *Soc. Sci. Med*, 168, 16–29. 10.1016/j.socscimed.2016.08.047. [PubMed: 27637089]
- Arnett JJ, 2000 Emerging adulthood: A theory of development from the late teens through the twenties. *Am. Psychol*, 55, 469 10.1037/0003-066X.55.5.469. [PubMed: 10842426]
- Arnett JJ, 2005 The developmental context of substance use in emerging adulthood. *J. Drug Issues*, 35, 235–254.
- Atkins DC, 2005 Using multilevel models to analyze couple and family treatment data: Basic and advanced issues. *J. Fam. Psychol*, 19, 98. [PubMed: 15796656]
- Atkins DC, Baldwin SA, Zheng C, Gallop RJ, Neighbors C, 2013 A tutorial on count regression and zero-altered count models for longitudinal substance use data. *Psychol. Addict. Behav*, 27, 166 10.1037/a0029508. [PubMed: 22905895]

- Bachman JG, Wadsworth KN, O'Malley PM, Johnston LD, Schulenberg JE, 2013 Smoking, Drinking, and Drug Use in Young Adulthood: The Impacts of New Freedoms and New Responsibilities. New York: Psychology Press.
- Barnes GM, Welte JW, Hoffman JH, Tidwell M-CO, 2010 Comparisons of gambling and alcohol use among college students and noncollege young people in the United States. *J. Am. Coll. Health*, 58, 443–452. 10.1080/07448480903540499. [PubMed: 20304756]
- Bates D, Mächler M, Bolker B, Walker S, 2014 Fitting linear mixed-effects models using lme4. *J. Stat. Softw.*, 67, 1–48. 10.18637/jss.v067.i01.
- Brenner AB, Borrell LN, Barrientos-Gutierrez T, Roux AVD, 2015 Longitudinal associations of neighborhood socioeconomic characteristics and alcohol availability on drinking: Results from the Multi-Ethnic Study of Atherosclerosis (MESA). *Soc. Sci. Med.*, 145, 17–25. 10.1016/j.socscimed.2015.09.030. [PubMed: 26439763]
- Cadigan JM, Duckworth JC, Parker ME, Lee CM, 2019 Influence of developmental social role transitions on young adult substance use. *Curr. Opin. Psychol.*, 30, 87–91. 10.1016/j.copsyc.2019.03.006. [PubMed: 31048248]
- Cambren C, Kosterman R, Rhew IC, Catalano RF, Guttmanova K, Hawkins JD, 2017 An examination of alcohol use disorder symptoms and neighborhood disorganization from age 21 to 39. *Am. J. Community Psychol.*, 60, 267–278. 10.1002/ajcp.12160. [PubMed: 28940467]
- Carbia C, Cadaveira F, Caamano-Isorna F, Rodriguez-Holguin S, Corral M, 2017 Binge drinking during adolescence and young adulthood is associated with deficits in verbal episodic memory. *PLoS One*, 12, e0171393 10.1371/journal.pone.0171393. [PubMed: 28152062]
- Cerdá M, Diez-Roux AV, Tchetgen ET, Gordon-Larsen P, Kiefe C, 2010 The relationship between neighborhood poverty and alcohol use: Estimation by marginal structural models. *Epidemiol.*, 21, 482 10.1097/EDE.0b013e3181e13539.
- Chaix B, 2018 Mobile sensing in environmental health and neighborhood research. *Annu. Rev. Publ. Health*, 39, 367–384. <https://doi.org/annurev-publhealth-040617-013731>.
- Collins RL, Parks GA, Marlatt GA, 1985 Social determinants of alcohol consumption: The effects of social interaction and model status on the self-administration of alcohol. *J. Consult. Clin. Psychol.*, 53, 189. [PubMed: 3998247]
- Curran PJ, Bauer DJ, 2011 The disaggregation of within-person and between-person effects in longitudinal models of change. *Annu. Rev. Psychol.*, 62, 583–619. 10.1146/annurev.psych.093008.100356. [PubMed: 19575624]
- Dawson DA, Grant BF, Stinson FS, Chou PS, 2004 Another look at heavy episodic drinking and alcohol use disorders among college and noncollege youth. *J. Stud. Alcohol*, 65, 477–488. [PubMed: 15378804]
- Diez-Roux AV, 2007 Neighborhoods and health: Where are we and where do we go from here? *Revue D'Epidemiologie et de Sante Publique*, 55, 13–21. 10.1016/j.respe.2006.12.003.
- Diggle P, Diggle PJ, Heagerty P, Liang KY, Heagerty PJ, Zeger S, 2002 *Analysis of Longitudinal Data*. Oxford: Oxford University Press.
- Duncan SC, Duncan TE, Stycker LA, 2002 A multilevel analysis of neighborhood context and youth alcohol and drug problems. *Prev. Sci.*, 3, 125–133. [PubMed: 12088137]
- Elder RW, Shults RA, Swahn MH, Strife BJ, Ryan GW, 2004 Alcohol-related emergency department visits among people ages 13 to 25 years. *J. Stud. Alcohol*, 65, 297–300. [PubMed: 15222585]
- Environmental Systems Research Institute (ESRI), 2014 ArcGIS Release 10.6. Redlands, CA.
- Freisthler B, Lipperman-Kreda S, Bersamin M, Gruenewald PJ, 2014 Tracking the when, where, and with whom of alcohol use: Integrating ecological momentary assessment and geospatial data to examine risk for alcohol-related problems. *Alcohol Res*, 36, 29. [PubMed: 26258998]
- Gfroerer JC, Greenblatt JC, Wright DA, 1997 Substance use in the US college-age population: Differences according to educational status and living arrangement. *Am. J. Public Health*, 87, 62–65. [PubMed: 9065228]
- Grant BF, Goldstein RB, Saha TD, Chou SP, Jung J, Zhang H, Pickering RP, Ruan JW, Smith SM, Huang B, Hasin DS, 2015 Epidemiology of DSM-5 alcohol use disorder: Results from the National Epidemiologic Survey on Alcohol and Related Conditions III. *JAMA Psychiatry*, 72, 757–766. 10.1001/jamapsychiatry.2015.0584. [PubMed: 26039070]

- Hingson RW, 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. *J. Stud. Alcohol Drugs*, 78, 540–548. 10.15288/jsad.2017.78.540. [PubMed: 28728636]
- Jokela M, 2015 Does neighbourhood deprivation cause poor health? Within-individual analysis of movers in a prospective cohort study. *J. Epidemiol. Community Health*, 69, 899–904. 10.1136/jech-2014-204513. [PubMed: 25878354]
- Kahler CW, Strong DR, Read JP, 2005 Toward efficient and comprehensive measurement of the alcohol problems continuum in college students: The Brief Young Adult Alcohol Consequences Questionnaire. *Alcohol Clin. Exp. Res*, 29, 1180–1189. 10.1097/01.ALC.0000171940.95813.A5. [PubMed: 16046873]
- Karriker-Jaffe KJ, Zemore SE, Mulia N, Jones-Webb R, Bond J, Greenfield TK, 2012 Neighborhood disadvantage and adult alcohol outcomes: Differential risk by race and gender. *J. Stud. Alcohol Drugs*, 73, 865–873. [PubMed: 23036203]
- Mair C, Frankeberger J, Gruenewald PJ, Morrison CN, Freisthler B, 2019 Space and place in alcohol research. *Curr. Epidemiol. Rep*, 6, 412–422.
- Martin Storey A, Ruttelle PL, Temcheff CE, Serbin LA, Stack DM, Ledingham JE, Schwartzman AE, 2013 Longitudinal and concurrent pathways to alcoholism: The importance of perception of neighborhood disorder. *J. Community Psychol*, 41, 156–174.
- Matheson FI, White HL, Moineddin R, Dunn JR, Glazier RH, 2012 Drinking in context: The influence of gender and neighbourhood deprivation on alcohol consumption. *J. Epidemiol. Community Health*, 66, e4–e4. 10.1136/jech.2010.11244. [PubMed: 21330461]
- McKinney CM, Chartier KG, Caetano R, & Harris TR, 2012 Alcohol availability and neighborhood poverty and their relationship to binge drinking and related problems among drinkers in committed relationships. *J. Interpers. Violence*, 27, 2703–2727. [PubMed: 22890980]
- Nahum-Shani I, Smith SN, Spring BJ, Collins LM, Witkiewitz K, Tewari A, Murphy SA, 2017 Just-in-time adaptive interventions (JITAs) in mobile health: Key components and design principles for ongoing health behavior support. *Ann. Behav. Med*, 52, 446–462. 10.1007/s12160-016-9830-8.
- Patrick ME, Rhew IC, Lewis MA, Abdallah DA, Larimer ME, Schulenberg JE, Lee CM, 2018 Alcohol motivations and behaviors during months young adults experience social role transitions: Microtransitions in early adulthood. *Psychol. Addict. Behav*, 32, 895 10.1037/adb0000411. [PubMed: 30556714]
- Rhew IC, Kosterman R, Duncan GE, Mair C, 2018. Examination of cross-sectional associations of neighborhood deprivation and alcohol outlet density with hazardous drinking using a twin design. *J. Stud. Alcohol Drugs*, 79, 68–73. 10.15288/jsad.2018.79.68. [PubMed: 29227233]
- Rhew IC, Kosterman R, Lee JO, 2017 Neighborhood typologies associated with alcohol use among adults in their 30s: A finite mixture modeling approach. *J. Urban Health*, 94, 542–548. [PubMed: 28484960]
- Rothman KJ, Gallacher JE, Hatch EE, 2013 Why representativeness should be avoided. *Int. J. Epidemiol*, 42, 1012–1014. 10.1093/ije/dys223. [PubMed: 24062287]
- Sampson RJ, Groves WB, 1989 Community structure and crime: Testing social-disorganization theory. *AJS*, 94, 774–802.
- Schulenberg JE, Johnston LD, O'Malley PM, Bachman JG, Miech RA, Patrick ME, 2018 Monitoring the Future national survey results on drug use, 1975-2017: Volume II, college students and adults ages 19-55.
- Schulenberg JE, Maggs JL, 2002 A developmental perspective on alcohol use and heavy drinking during adolescence and the transition to young adulthood. *J. Stud. Alcohol*, Supplement 14, 54–70. 10.15288/jsas.2002.s14.54.
- Slutske WS, 2005 Alcohol use disorders among US college students and their non-college-attending peers. *Archives Gen. Psychiatry*, 62, 321–327.
- Stahler GJ, Mennis J, Baron DA, 2013 Geospatial technology and the “exposome”: New perspectives on addiction. *Am. J. Public Health*, 103, 1354–1356. [PubMed: 23763413]
- R Core Team, 2013 R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing.

- White AM, Slater ME, Ng G, Hingson R, Breslow R, 2018 Trends in alcohol-related emergency department visits in the United States: Results from the Nationwide Emergency Department Sample, 2006 to 2014. *Alcohol Clin. Exp. Res*, 42, 352–359. 10.1111/acer.13559. [PubMed: 29293274]
- Winstanley EL, Steinwachs DM, Ensminger ME, Latkin CA, Stitzer ML, Olsen Y, 2008 The association of self-reported neighborhood disorganization and social capital with adolescent alcohol and drug use, dependence, and access to treatment. *Drug Alcohol Depend.*, 92, 173–182. 10.1016/j.drugalcdep.2007.07.012. [PubMed: 17913396]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

### Highlights

- This study used monthly data over 2 years on neighborhood poverty and alcohol use in young adults.
- When living in higher poverty neighborhoods, young adults reported more alcohol-related consequences.
- Young adults may benefit from intervention approaches that consider their neighborhood context.

**Table 1.**

## Characteristics of the study sample

Characteristic	Mean (SD) or %
Male sex	43.6
Race	
White	59.1
Asian	18.2
Other	22.7
Hispanic ethnicity	8.3
Highest level of parental education	
High school diploma or less	10.1
Some college, trade, or vocational school	23.8
Bachelor's degree	29.7
Graduate or professional degree	36.4
Baseline age	20.6 (1.7)
Number of moves	1.6 (1.5)
Baseline number of financial difficulties	1.7 (1.4)
Proportion of months attending 4-year college	37.6 (41.1)
Proportion of months living at parents' home	32.3 (36.0)



**Table 2.**

Results from generalized linear mixed effects models for association of neighborhood poverty and other covariates with past month typical drinking.

	CR	95% CI	p-value
<u>Neighborhood covariates</u>			
Average neighborhood poverty	1.23	1.07, 1.41	0.003
Monthly deviation in neighborhood poverty	1.04	0.99, 1.10	0.120
<u>Time-fixed covariates</u>			
Male sex	1.24	0.99, 1.54	0.057
Non-heterosexual orientation	0.65	0.50, 0.85	0.002
Hispanic ethnicity	1.20	0.80, 1.81	0.378
Race			
White (reference)	--	--	--
Asian	0.48	0.36, 0.65	<0.001
Other	0.79	0.6, 1.05	0.105
Highest level of parental education	1.23	0.97, 1.57	0.089
Baseline financial difficulties	1.14	0.88, 1.47	0.312
Baseline age	1.06	0.99, 1.13	0.101
<u>Time-varying covariates</u>			
Time since baseline in years	0.93	0.90, 0.96	<0.001
Attending 4-year college	1.15	1.08, 1.23	<0.001
Living with parents	0.80	0.75, 0.84	<0.001
Changed residence last month	1.10	1.04, 1.17	0.001
<u>Random Effects</u>			
	<u>SD</u>		
Census-tract-level intercept	0.67		
Person-level intercept	1.44		

**Table 3.**

Results from generalized linear mixed effects models for association of neighborhood poverty and other covariates with past month number of alcohol-related consequences.

	CR	95% CI	p-value
<u>Neighborhood covariates</u>			
Average neighborhood poverty	1.27	1.1, 1.46	0.001
Monthly deviation in neighborhood poverty	1.05	1.00, 1.11	0.045
<u>Time-fixed covariates</u>			
Male sex	0.83	0.66, 1.06	0.133
Non-heterosexual orientation	0.62	0.46, 0.83	0.001
Hispanic ethnicity	1.00	0.64, 1.56	0.995
Race			
White (reference)	--	--	--
Asian	0.48	0.35, 0.67	<0.001
Other	0.91	0.67, 1.23	0.539
Highest level of parental education	1.24	0.96, 1.61	0.100
Baseline financial difficulties	1.43	1.09, 1.88	0.010
Baseline age	1.00	0.94, 1.08	0.893
<u>Time-varying covariates</u>			
Time since baseline in years	0.80	0.77, 0.84	<0.001
Attending 4-year college	1.19	1.1, 1.3	<0.001
Living with parents	0.78	0.73, 0.84	<0.001
Changed residence last month	1.03	0.96, 1.11	0.397
<u>Random Effects</u>			
	<u>SD</u>		
Census-tract-level intercept	0.56		
Person-level intercept	1.55		