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Roles of Race and Adverse Neighborhood Conditions in Urban Youth Alcohol Behavior

Jin Zhao
Syracuse University

Abstract

Substantial racial disparities exist in adolescent alcohol behaviors. Although racial minority adolescents are less likely to drink, when they drink, they experience similar or greater levels of negative drinking consequences compared to Whites. However, such racial disparities have rarely been examined within the neighborhood environmental context. This study examined whether racial differences exist in the prospective association between adverse neighborhood conditions (i.e., disadvantage and disorder) at Year 1 (Y1) and adolescents' current drinker status and risk for hazardous drinking at Year 2 (Y2) in racially diverse urban high school students. Data were drawn from a two-wave, one-year prospective health study of 9th to 11th graders enrolled in an urban public high school in the Northeastern U.S. (N = 386; M_{age} = 15.98 years [SD = 1.07]; 44% male; 18% Asian, 43% Black, 16% Multiracial, 22% White; 11% Hispanic). Results from prospective hurdle models showed no significant interactions between race and neighborhood conditions (neither disadvantage nor disorder) at Y1 for both drinker status and risk for hazardous drinking at Y2. After controlling for neighborhood disadvantage and disorder at Y1, White and Multiracial adolescents were more likely to be current drinkers (but not engage in hazardous drinking) at Y2 than Asian and Black adolescents. Results suggest that Multiracial adolescents may be at a similar risk for alcohol consumption as White adolescents and that the racial differences in the risk for alcohol consumption may not be explained by neighborhood disadvantages and perceived disorder. Future prospective research needs to replicate these results with a larger sample of adolescents from diverse neighborhood characteristics.

Keywords: alcohol, adolescent, racial disparity, neighborhood disadvantage, neighborhood disorder

Roles of Race and Adverse Neighborhood Conditions in Urban Youth Alcohol Behavior

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Jin Zhao

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Underage drinking is a serious public health concern. Approximately 75% of high school seniors in the United States reported drinking at least once in their lifetime and 45% reported current drinking (Subica & Wu, 2018). The prevalence of binge drinking, defined as ever having at least five [for men]/four [for women] drinks in one sitting during the past two weeks (National Institute on Alcohol Abuse and Alcoholism (NIAAA), 2016) has been shown to escalate from 4% in eighth grade to 10% in 10th grade and 17% in 12th grade (Johnston et al., 2018). Alcohol consumption during adolescence may have severe short-term consequences such as, heightened suicide risk, structural changes to the developing brain, and academic performance decline (National Institute on Alcohol Abuse and Alcoholism, 2017). Heavy drinking during adolescence is associated with a higher likelihood to encounter long-term consequences during adulthood, such as, economic difficulties, social dysfunctions, and alcohol and substance use disorders (Cerda et al., 2016). Given the deleterious short-term and long-term consequences of adolescent alcohol use, it is crucial to identify the diverse risk factors associated with drinking behaviors during this critical developmental period.

Minority adolescents report substantially different alcohol use and alcohol-related negative consequences than their White peers. Both cross-sectional and longitudinal analyses have found that White adolescents were less likely to be abstainers and initiated drinking earlier than their Asian and Black peers (Flewelling & Bauman, 1990; Johnston et al., 2018). A recent national study found that among U.S. monoracial high school students, non-Hispanic Whites reported the highest maximum alcohol quantity and the most frequent binge drinking episodes, whereas Asian and Black adolescents reported lower alcohol use frequency and quantity (Jang et

al., 2017). Similar racial differences in adolescent alcohol use were observed in non-national studies (Fish et al., 2018; Hahm et al., 2004). Likewise, racial demographics were also associated with adolescents' alcohol-related negative consequences. White adolescents reported more frequent alcohol-related negative consequences than racial minorities (Maldonado-Molina et al., 2011). However, among adolescent heavy drinkers, Whites reported less alcohol-related social consequences and accidents. than racial minorities (Bailey & Rachal, 1993). These trajectories extend into adulthood, such that Black adults who began drinking in adolescence report more long-term negative consequences than White adults who began drinking in adolescence (Mulia et al., 2009). These racial differences in adolescent alcohol use and consequences highlight the need for identifying factors that may accentuate or mitigate alcohol-related health disparities.

An often-understudied racial group in adolescent drinking is Multiracial adolescents, which is the fastest growing youth population in the United States (U.S. Census Bureau, 2010). Research suggests a disparity in alcohol use between monoracial and multiracial adolescents (Choi et al., 2006). Multiracial high school students, compared to monoracial minorities (i.e., Asian, Black, and Native Americans) and non-Hispanic Whites, reported more frequent drinking, and a higher prevalence of alcohol use disorder, after adjusting for age, sex, family income, local population density and self-reported health (Wu et al., 2011). Udry and colleagues (2003) demonstrated that multiracial adolescents overall experience more frequent episodes of alcohol intoxication compared to monoracial adolescents. The same study also found that two multiracial subgroups with White ancestry (White-Asian and White-American Indian) endorsed more frequent alcohol use than monoracial Whites. Despite the emerging evidence for multiracial adolescents' heightened rates of alcohol use and problematic use, few studies have explored risk factors for multiracial adolescent drinking patterns.

Adverse Neighborhood Conditions

The current adolescent alcohol literature largely focuses on person-level characteristics (e.g., personality traits, alcohol expectancies, and motives) and proximal social systems (e.g., peer drinking norms) as risk factors (e.g., Comeau et al., 2001; Hawkins et al., 1992; Iwamoto & Smiler, 2013; Wood et al., 2004). Developmental-ecological models (Bronfenbrenner, 1979) highlight the importance of integrating broader social contextual factors to conceptualize adolescent behaviors, including adolescent alcohol behaviors (Pedersen et al., 2018). However, adverse environmental contexts, which can induce cumulative long-term negative impacts on the residents' behavior (Bronfenbrenner, 1999; Dodge et al., 2009), have often been inadequately studied in the current literature (Pedersen et al., 2018; Sudhinaraset et al., 2016). Prevailing social disorganization theories integrate social contextual factors by highlighting community norms, which can outline the range of acceptable behaviors and inhibit unhealthy behavior by exerting social control. Such theories suggest that a disadvantaged neighborhood alters existing community norms, thereby disrupting social control (Arabian & Quartey, 2006; Bernburg & Thorlindsson, 2005; Hirschi, 1969; Petraitis et al., 1995). The deterioration of social control increases the likelihood of occurrence and normalization of unhealthy behaviors in youth (Brenner et al., 2011; Kingston et al., 2009). Eroded social control and neighborhood-level psychosocial stressors are thought to alter community norms that normalize unhealthy behaviors, such as alcohol misuse (Elliott et al., 1996; Ennett et al., 2008).

Social disorganization theories stimulated research on the importance of the neighborhood environment on diverse problematic behaviors including alcohol use behaviors. Among adults, stressors and deteriorated social control, associated with living in an adverse neighborhood, are thought to be the primary mechanisms by which the neighborhood

environment drives the residents' alcohol use (Barr, 2018). Indeed, adverse neighborhood conditions have been associated with higher likelihood of binge drinking, and higher levels of alcohol quantity and frequency in adult drinkers (Jones-Webb & Karriker-Jaffe, 2013; Karriker-Jaffe et al., 2018). However, much of the prior adolescent research based on social disorganization theories focused on violent and criminal behaviors (as opposed to alcohol use behaviors) as outcomes (i.e., Garthe et al., 2018; Haynie et al., 2006). A notable exception is a large-scale cross-sectional study of Dutch and Australian national health data registries; in both countries, adolescent alcohol consumption quantity, frequency, and binge drinking all varied significantly between neighborhood communities that were geographically defined by local government ordinances (Jonkman, Steketee, Tombourou, Cini, & Williams, 2014). In contrast, a systematic review on 23 multilevel neighborhood studies did not find evidence for any direct links between adverse neighborhood conditions and adolescent alcohol use and misuse (N. Jackson, Denny, & Ameratunga, 2014). Further, the same review noted that the existing literature is limited by the predominantly cross-sectional study designs and insufficient power to properly test potential moderating factors in the neighborhood-adolescent alcohol associations.

Neighborhood Disadvantage

A neighborhood's socioeconomic disadvantage deprives adolescents of the proper resources and renders them more vulnerable to risky and unhealthy behaviors. Neighborhood-level socioeconomic disadvantage measures often include indicators of income disparity among the residents (Gruenewald et al., 2010; Morenoff et al., 2001) or number of residents living below poverty (Massey, 2001). However, binge drinking and total alcohol consumption quantity among adolescents have not been associated with neighborhood poverty (Aslund & Nilsson, 2013; Fagan et al., 2007; Vinther-Larsen et al., 2013). One of the largest neighborhood health

studies to date used longitudinal data from the Swedish health registry (Karriker-Jaffe et al., 2018) and reported that childhood exposure to neighborhood-level socioeconomic deprivation increases the likelihood of alcohol use disorder during adolescence for a small subsample. Adolescent literature in neighborhood-alcohol associations has frequently cited common reasons for equivocal neighborhood disadvantage findings. One such reason is the lack of high-quality longitudinal and multilevel-design studies that include diverse sociodemographic groups with sufficient within-group variation in socioeconomic deprivation (N. Jackson et al., 2014).

Neighborhood Disorder

Related to, but yet distinct from neighborhood disadvantage, neighborhood disorder is another key neighborhood characteristic associated with the residents' alcohol use behaviors. Neighborhood disorder consists of physical and social disorder. Physical disorder refers to the physical and visible signs of crime and disorganization such as loud noises, abandoned buildings, and litter (Ross & Mirowsky, 2001). Social disorder refers to neighborhood attributes that inhibit social control through crimes, violence, and other disorderly conducts such as, loitering and public drunkenness (Innes, 2003; Sampson & Raudenbush, 1999). Although disadvantaged neighborhoods tend to show higher levels of disorder such as crime and violence (Sampson & Raudenbush, 1999; Sampson et al., 1997), varying levels of physical and social disorder can occur at similar levels of neighborhood-level poverty. Repeated exposure to the psychosocial stressors due to a disordered neighborhood has been prospectively associated with adolescent alcohol misuse (Hill & Angel, 2005; Tobler et al., 2011). Adolescents who reported feeling unsafe in the neighborhood also reported less hope and more frequent alcohol use (Wilson et al., 2005). In a sample of racially diverse high school students, participants who reported their neighborhoods to be unsafe and disadvantaged also reported more episodes of drunkenness and

more frequent substance use, than participants who lived in more affluent areas (Choi et al., 2006). Together, studies of neighborhood disorder consistently have shown to be associated with adolescent alcohol use behaviors.

Racial Differences in Adverse Neighborhood Conditions

A paucity of research suggests a literature gap concerning the racial differences in the neighborhood influences on adolescent alcohol behaviors. Health disparities research suggests that racial minority adolescents face greater exposure to accumulative psychosocial stress over their lifespan (Theall et al., 2012; Williams et al., 2018). Such differential exposure to stressors can render an individual more susceptible to the consequences of additional psychosocial stressors Self-reported neighborhood disadvantage (assessed as percentage of residents who live below the federal poverty line) and disorder (assessed as lack of safety) were more positively associated with alcohol use and drunkenness among Multiracial adolescents than White, Asian American and African American adolescents (Choi et al., 2006). A large prospective multilevel study found that neighborhood disadvantage is positively associated with past-year drinking prevalence among African American adolescents but not among White adolescents; past-month binge drinking prevalence and neighborhood disadvantage association did not differ across racial demographics (Fagan et al., 2013). However, it is important to note that past studies featured predominantly White adolescent samples or included Black adolescents as the sole racial minority comparison. Meanwhile, Asian adolescents have historically been left out of comparisons, and multiracial adolescents are nonexistent in neighborhood-alcohol association studies. More research involving diverse racial groups is necessary to ascertain specific neighborhood attributes associated with racial disparities in adolescent alcohol behavior.

Study Aims and Hypotheses

The current study aimed to characterize potential racial differences in the relationships between adverse neighborhood conditions and alcohol behaviors in urban high school students. Specifically, this study examined whether exposures to neighborhood disadvantage and disorder were associated with alcohol behaviors concurrently and prospectively among racial minority adolescents (Asian, Black, and multiracial) compared to their White peers. For the purposes of this study, adolescent alcohol behaviors have been operationalized into two constructs: (1) the likelihood to endorse current drinker status, (2) and risk level for hazardous alcohol use for drinkers (i.e., assessed by combining level of consumption, dependence symptoms, and the number of negative alcohol consequences). Secondary data analyses were conducted on data obtained from a two-wave, one-year prospective study of 414 9th to 11th graders enrolled in an urban public-school district. Based on the limited extant cross-sectional and prospective research (Fagan et al., 2013; N. Jackson et al., 2014), cross-sectional and prospective association of adverse neighborhood conditions with current drinker status and hazardous drinking was hypothesized to be stronger in Black adolescents as compared to White adolescents. Multiracial adolescents were hypothesized to have a higher drinking prevalence than Whites in disadvantaged neighborhood. No *a priori* hypothesis was considered regarding Asian adolescents as compared Whites within the neighborhood context, due to absence of prior research.

Method

Participants

This study utilized data from *Project Teen,* a two-wave one-year prospective survey study of adolescent health behaviors. Participants were 414 students enrolled in an urban public high school located in the Northeastern U.S. (N = 414, 43% male, M_{age} = 16 years [SD = 1.08,

range = 13.61 – 19.62]; 18% Asian, 41% Black, 17% Multiracial, 2% Native Hawaiian/Pacific Islanders or American Indian/Alaska Native, 21% White; 11% Hispanic ethnicity). Eligible participants were English-speaking students who were enrolled in 9th, 10th, or 11th grade. Students were ineligible if enrolled in the 12th grade, because they were expected to graduate from high school prior to or at the time of the one-year follow-up assessment and thus their alcohol use and its correlates may differ from those of high school students. Participants were recruited through class visits during their regular class periods and were introduced to "an opportunity to participate in a research project designed to promote healthy lifestyles among youth." Participants completed two web-based surveys at Year 1 (Y1) and Year 2 (Y2) with an interval of 12 months ($M_{interval}$ = 389.05 days [*SD* = 27.36 days]). Out of the 414 participants at Y1, 89% (*n* = 367) also completed a survey at Y2. This urban sample represents substantial socioeconomic disadvantage on average, as indicated by 87% eligible for a free or reduced-price lunch program, 27% having a primary care giver without high school diploma, and 75% living in a neighborhood where at least 20% of residents fall below the federal poverty line (U.S. Census Bureau, 2017).

Of the 414 participants at Y1, 28 were excluded from the current analyses due to unverifiable home addresses that were not matched to census tracts (*n* = 19; 5% of the original sample) or small racial group sizes (*n* = 9 Native Hawaiian/Pacific Islanders or American Indian/Alaska Native; 2% of the original sample). Y1 data obtained from the remaining 386 participants (M_{age} = 15.98 years [*SD* = 1.07], range = 13 – 17; 44% male; 18% Asian, 43% Black, 16% Multiracial, 22% White; 11% Hispanic) were used for cross-sectional analyses. Both Y1 and Y2 data obtained from 345 participants who participated both assessments (non-attriters;

56% female, M_{age} = 16.46 years [*SD* = 1.08, range = 14 – 18], 10 % Hispanic ethnicity; 18% Asian; 44% Black, 22% White, 16% multiracial) were used for prospective analyses.

Results from attrition analyses showed that participants who dropped out from this study at Y2 (M_{age} = 16.37, *SD* = 1.08) were significantly older than participants who remained in the study (M_{age} = 15.95, *SD* = 1.07). Otherwise, no significant differences were detected in any other study variables between those who dropped out and those who remained in the study at $p < .05$.

Procedure

Study procedures were reviewed and approved by the institutional review board, the school district, and the school principal. To further protect the confidentiality of the participants' sensitive data (e.g., underage drinking), a certificate of confidentiality was obtained from the National Institutes of Health. Eligible, interested students provided written assent and parent/guardian consent. Most students used a computer (outfitted with a privacy screen to protect confidentiality) at their school library to access an online survey link via *RedCap* (Harris et al., 2009), a secured web-based data collection platform, during regular class periods. A few participants, however, completed the survey outside of school hours using personal computers or smartphones with internet connection. Voice survey options were available to participants who preferred listening to survey responses rather than reading them. Throughout survey completion, students were encouraged by both electronic prompts and research staff that their answers would remain confidential. Upon completion of the survey, participants received monetary compensation in the form of gift cards, up to $20 commensurate upon the proportion of survey completed. Additionally, any student who returned a complete parental consent (regardless of their actual participation) could receive extra credit based on individual teacher discretion. For the parent study, participants also had the option to provide a DNA sample via cheek swab for an

additional $5 monetary compensation at Y1, although genotypes were not used for the current study. Protocols for Y2 assessment are identical to Y1 assessment except for the informed consent/assent and DNA sample collection.

Measures

Current Drinker Status and Hazardous Alcohol Use. Two alcohol outcomes were measured with the Alcohol Use Disorder Identification Test (AUDIT; Babor, Higgins-Biddle, Saunders, Monteiro, & World Health Organization, 2001; Saunders, Aasland, Babor, De la Fuente, & Grant, 1993) at both Y1 and Y2. The AUDIT comprises of 10 items that constitute the following three subscales: alcohol consumption frequency (3 items; range = 0 – 12), alcohol dependence (3 items; range = 0 – 12), and alcohol-related negative consequences (4 items; range = 0 – 16). The overall sum score (range = 0 – 40) at Y2 was the main outcome variable. The AUDIT is a reliable measure of risk for hazardous use that has been validated in adolescent samples (Knight, Sherritt, Harris, Gates, & Chang, 2003; Meneses-Gaya, Zuardi, Loureiro, & Crippa, 2009). All zeroes obtained from the AUDIT scores were generated solely by non-drinking or abstaining participants, therefore, the current drinker status variable (yes/no) was created by the logistic portion of the hurdle models used in the main analyses, which dichotomized the AUDIT. Positive nonzero scores were coded as “current drinkers” and scores of zeroes were coded as “non-current drinkers”. Consequently, “non-current drinkers” included adolescents who never initiated drinking, those who initiated drinking but have abstained from recent drinking, and those whose drinking frequency below “monthly or less” as indicated on the responses to the AUDIT question “How often do you have a drink containing alcohol?” The Y1 sum score was used as a main outcome variable for cross-sectional analyses and as a covariate

for prospective analyses. The Y2 sum score was used as a main outcome variable for prospective analyses.

Neighborhood Disadvantage. Annual projected census data were used to represent objective neighborhood-level socioeconomic levels. Thus, the neighborhood was operationalized as the corresponding census tracts of self-reported home addresses that were recorded at Y1. Census data were obtained from the U.S. Census Bureau's 2017 American Community Survey (U.S. Census Bureau, 2017) corresponding to the year of Y1 assessment when home address data were collected. Participants' home addresses were first matched to census tract by using the Census Bureau's web-based batch geocoding function and unmatched addresses were automatically expelled. Next, we used *PolicyMap*, a web-based aggregator of census and municipal data to manually correct and verify the unmatched addresses to find the corresponding census tracts. Data from 19 participants whose home addresses remained invalid were excluded from the current analyses. In total, we identified 53 census tracts for the 386 participants at Y1. We also recorded the number of residents per census tract (M = 7.28; Mdn = 3 [interquartile range = 1.00 – 10.50]). Then, a composite "disadvantage index" was calculated for each participant to assess neighborhood-level disadvantage at Y1 based on the method used in a previous study of neighborhood disadvantage and alcohol use in men (Zemore et al., 2016). A composite index is able to capture multiple measures of socioeconomic wellbeing of a given geographical areas simultaneously. Specifically, the composite index was the average of four census tract-level socioeconomic indicators from the U.S. Census Bureau's 2017 American Community Survey: (1) percentage of all residents living below the federal poverty level (M = 34%; SD = 18%; range = 3 – 83%); (2) percentage of adult residents without high school diploma (M = 21%; SD = 14%; range = 2 – 48%); (3) percentage of unemployed residents who

are age 16 or older (*M* = 12%; *SD* = 7%; range = 1 – 32%); (4) percentage of residents who are age 16 or older with working-class jobs (*M* = 65%; *SD* = 16%; range = 32 – 91%). The current neighborhood disadvantage index (*M* = 33%; *SD* = 11%; range = 16 – 53%) showed good internal consistency (Cronbach's α = 0.78), slightly lower than the consistency (Cronbach's α = 0.89) reported by Zemore et al. (2016).

Perceived Neighborhood Disorder. Five items from the Communities That Care Youth Survey (Arthur et al., 2002) measured participants' perceived neighborhood disorder at Y1. Participants were asked to indicate how well each item described their neighborhood (i.e., "crime and/or selling drugs", "fights", "lots of graffiti", "lots of empty or abandoned buildings", and "I feel safe in my neighborhood"). Each item was rated on a 4-point scale ranging from 1 (*Not at all true*) to 4 (*Very True*). A sum score was used for analyses (*M* = 8.38; *SD* = 3.60; range = 5 – 20), with higher scores indicating greater perceived neighborhood disorder. This scale has shown high reliability in both male and female adolescents in the original national study (Cronbach's α = 0.83 – 0.85; Arthur et al., 2007) and an acceptable reliability in the current sample (Cronbach's α = 0.66).

Race and Other Demographics. Participants reported their race by selecting one of the following: Asian, Black or Black, Multiracial, White, Native Hawaiian/Pacific Islander and American Indian/Alaska Native (Center for Disease Control, 2013).The latter two categories were excluded at Y1 for the current analyses due to extremely small group size (*n* = 9) and thus were challenges for inferential data analyses.

Given that demographic characteristics have been associated with adolescent alcohol use behaviors and consequences, four sociodemographic covariates were included in the main analyses. Adolescent age has been shown to positively associated with frequency of various

alcohol consumption behaviors and amount of alcohol consumed (rounded down to the nearest interger; D'Amico et al., 2005). Hispanic/Latinx (0 = *no*, 1 = *yes*; Gil et al., 2000; Truong & Sturm, 2009) adolescents have also shown to have lower rates of alcohol use frequency and consumption amount than Whites. Lastly, regarding biological sex (0 = *female,* 1 = *male*; Nolen-Hoeksema, 2004; Wilsnack et al., 2000), males have been demonstrated to have more problematic drinking behaviors than females. All sociodemographic covariates were assessed at Y1 and included in main analyses models.

Data Analytic Strategy

Descriptive Statistics. Descriptive statistics for both Y1 and Y2 variables were calculated in *RStudio* version 1.1.463 (RStudio Team, 2016) and using the *tidyverse* work environment (Wickham, 2017). Bivariate correlations were computed for all study variables. Pearson's coefficients were used for correlations between two continuous variables, Spearman's coefficients for correlation between continuous and dichotomous/count variables, and phi coefficients were used for correlations between two dichotomous variables.

Data Diagnostics. Data diagnostic inspection and analyses were conducted with *RStudio* version 1.1.463 (RStudio Team, 2016). Shapiro-Wilke normality tests and graphical inspection of all study variables were used to identify outliers, skewness, kurtosis and non-normality. For participants who reported no lifetime alcohol use, zeroes were imputed in all alcohol outcome variables (Bradley et al., 2007; Bush et al., 1998). Shapiro-Wilk normality tests found the AUDIT sum scores at Y1 and Y2 to have abnormally distributed residuals at $p < 0.01$. Kurtosis scores calculated with the *e1071* package (Meyer et al., 2018) found kurtosis scores greater than 20, which indicated extreme leptokurtic residual distribution (George & Mallery, 2010). Dispersion test results conducted with the *AER* package (Kleiber & Zeileis, 2008) demonstrated

significant overdispersion (variance greater than mean) and excess zeroes, consistent with previous studies using the AUDIT in non-clinical samples (e.g., Funderburk et al., 2014; Lindgren et al., 2015).

Main Analyses. Hurdle models, a type of mixture models, were used to account for the overdispersion and excess zeroes (Hu et al., 2011) found in AUDIT sum scores in the data diagnostic analyses above. Due to the survey structure of the AUDIT, nonzero positive scores were generated exclusively from participants who were drinkers and zeroes were generated exclusively from participants who were non-current drinkers. Mixture models are required to address the assumption that a single outcome contains two separate but concurrent data generative processes (Baughman, 2007). The mixture model framework is consistent with the current literature indicating separate mechanisms for abstinence and hazardous drinking (Cambron et al., 2018; Pedersen et al., 2018; Wallace Jr et al., 2003). In general, a hurdle model has two portions. The first portion is a binary logit model, where logistic regression describes the probability of a participant endorsing a score of zero or a positive non-zero score. The second portion contains a truncated count model where a generalized linear model is fitted for the positive non-zero scores.

To determine the correct sampling distribution to estimate our data, dispersion tests were performed on the drinkers subsample data in order to specify the correct sampling distribution. Results showed that the overall AUDIT nonzero sum scores (i.e. drinkers) were significantly overdispersed (i.e. variance greater than mean) thus requiring negative binomial distributions to properly fit the drinkers' alcohol outcome data. Each hurdle model produces two sets of coefficients. Logistics coefficients can be interpreted as the probability of endorsing status as a drinker, similar to a traditional logit model. Then, truncated negative binomial regression

coefficients for the drinkers' (i.e. non-zero positive) count data are equivalent to any log-coefficients. Negative binomial hurdle models were constructed with the *pscl* package (Jackman, 2010; Zeileis et al., 2008). Effect sizes were reported for each predictor by calculating the odds ratios (OR) for the logit model and incidence rate ratios (IRR) for the count models.

Cross-sectional Analyses of the AUDIT Sum Score. Cross-sectional associations between the predictors and the alcohol outcomes at Y1 were first examined to aid the future interpretations of prospective models. A total of three cross-sectional hurdle models were estimated. The first hurdle model specified neighborhood disorder interacting with race along with their main effects. The second hurdle model specified neighborhood disadvantage interacted with race along with their main effects. The third combined model included interaction terms of race with both neighborhood disadvantage and perceived neighborhood disorder along with their main effects. All models also controlled for the covariates.

Prospective Analyses of the AUDIT Sum Score. Three prospective hurdle models were estimated using the identical predictor terms to the cross-sectional analyses for predicting Y2 alcohol outcomes while also controlling for Y1 AUDIT scores as a covariate.

Ancillary Analyses of the AUDIT Subscale Scores. Ancillary analyses utilized the three individual ADUIT subscales as outcomes in place of the overall sum score. Procedures were identical to the main analyses.

Power Analysis. A priori power analysis conducted with the pwr package (Champely, 2018) accommodated the interaction terms, main effects and covariates for the main prospective models. A study by Cambron et al. (2018) provided an effect size for association between neighborhood disadvantage and adolescent alcohol frequency ($R^2 = 0.06$). Results indicated that 318 participants are needed to achieve a threshold power of .80 at the two-tailed α level of .05,

indicating the current Y1 sample size (n = 386) and Y2 sample size (n = 342) offer sufficient statistical power for cross-sectional models and prospective models, respectively.

Consideration of Alternative Models. Due to presence of nested neighborhood structure in the current study, the necessity for the integration of hurdle models into a multilevel regression framework was assessed. Neighborhoods can significantly cluster the participants who are nested within (i.e., "village effect"; Duncan et al., 2002). Therefore, unaccounted correlation between participants of the same neighborhoods (within-neighborhood correlation) may inflate the Type-1 error rate (Krull & MacKinnon, 2001). Intraclass Correlation Coefficients (ICC; possible range = 0 – 1) were used to estimate the proportion of variance between neighborhoods versus within neighborhoods. Higher ICCs indicate greater differences between-neighborhood and higher correlation coefficients between participants within the same neighborhoods. Neighborhood studies using multilevel modeling frequently found ICC greater than 0.3 (e.g., Buckner, 1988; Mota et al., 2005). Unconditioned mixed-effect models of each outcome variable along with model convergence optimization were used to estimate the Y1 and Y2 sample within-neighborhood ICCs. ICCs were calculated with the *sjstats* package (Lüdecke, 2017) on unconditioned random intercept models constructed with the *glmmTMB* package (Brooks et al., 2017; Venables & Ripley, 2002). Out of the four AUDIT subscale and sum scores, the consumption subscale showed the biggest ICC at Y1 ($\rho_{|}$ = 0.10), which was very small in quantity, and the remaining AUDIT scores' ICCs were near zero. Thus, given the very small or zero within-neighborhood correlation, multilevel models were unnecessary and thus the aforementioned hurdle models were used for main data analyses.

Results

Descriptive Analyses

Means (and standard deviations) or proportions for all Y1 and Y2 study variables g are presented in Table 1. Bivariate correlations of all Y1 and Y2 study variables are presented in Table 2.

At Y1, 27% (n = 104) of the participants were current drinkers (defined as any past-year alcohol consumption, as indicated by nonzero positive scores on the AUDIT) and the proportion of current drinkers increased to 34% (n = 110) of non-attriters at Y2. Compared to Y1, an increase in the proportion of drinkers was observed across the four racial groups. White adolescents at both Y1 (n = 35; 41%) and Y2 (n = 41; 54%) had the highest percentage of drinkers within-group, compared to the three racial minority groups.

Cross-Sectional Hurdle Models

Model for Neighborhood Disadvantage. As shown in Table 3, results demonstrated no significant interaction effects between race and neighborhood disadvantage on drinker status (ORs = 0.07 – 1.03, ps = .37 – .84) and on risk for hazardous drinking (IRRs = 1.00 – 1.20, ps = .052 – .15) at Y1. After controlling for neighborhood disadvantage and the interactions, Asian (OR = 0.39, p =.03) and Black (OR = 0.31, p < .01) adolescents were less likely to be drinkers at Y1 than Whites. Meanwhile, Multiracial (OR = 1,47, p = .71) adolescents did not differ from Whites in the likelihood to be current drinkers. No racial differences were found to be associated with risk for hazardous alcohol use. Neighborhood disadvantage was not independently associated with drinking status (OR = 0.98, p = .54) and risk for hazardous drinking (IRR = 0.95, p = .22) at Y1, after accounting for race and covariates.

Model for Perceived Neighborhood Disorder. As shown in Table 4, results demonstrated no significant interactions of race with neighborhood disorder on drinker status (ORs = 0.88 – 0.98, ps = .26 – .86) or risk for hazardous drinking (IRRs = 0.85 – 1.05, ps = .42 –

.88) at Y1. After controlling for neighborhood disorder and the interactions, Black (OR = 0.24, $p < .01$) and Asian (OR = 0.29, $p < .01$) adolescents were less likely to be drinkers at Y1 compared to White adolescents. While Multiracial adolescents did not differ from Whites regarding their drinker status (OR = 0.90, $p = .80$) at Y1, Multiracial drinkers (IRR = 0.24, $p = .02$) were at lower risk for hazardous drinking than White drinkers. Neighborhood disorder was not independently associated with drinking status (OR = 1.07, $p = .47$) and risk for hazardous drinking (IRR = 1.09, $p = .44$) at Y1.

Combined Model for Both Neighborhood Disadvantage and Disorder. As shown in Table 5, results demonstrated no significant interactions of race with neighborhood disadvantage or perceived neighborhood disorder on drinking status (ORs = 0.86 – 1.04, *p*s = .22 – .85) and risk for hazardous drinking (IRRs = 0.74 – 1.14, *p*s = .08 – .72). After controlling for interactions and neighborhood characteristics, Black (OR = 0.29, $p < .01$) and Asian (OR = 0.38, $p = .03$) adolescents were both less likely than Whites to be drinkers. Multiracial (OR = 1.11, $p = .81$) adolescents did not differ from Whites in terms of their risk for being drinkers at Y1. None of the two neighborhood characteristics were independently associated with drinker status and risk for hazardous drinking at Y1.

Prospective Hurdle Models

Model for Neighborhood Disadvantage. As shown in Table 6, results demonstrated no significant interactions of race with Y1 neighborhood disadvantage on drinker status (ORs = 1.01 – 1.08, *p*s = .21 – .73) or risk of hazardous drinking (IRRs = 0.99 – 1.05, *p*s = .38 – .93) at Y2 after accounting for the same alcohol outcome at Y1 and covariates. After controlling for neighborhood disadvantage, Asian (OR = 0.34, $p = .02$), Black (OR = 0.37, $p = .01$), and Multiracial (OR = 0.88, $p = .02$) adolescents were all less likely than Whites to be Y2 drinker

status. However, race was not associated with Y2 risky for hazardous drinking (IRRs = 0.65 – 1.88, *p*s = .26 – .92). Neighborhood disadvantage at Y1 was associated with a lower likelihood for being drinkers at Y2 (OR = 0.94, $p = .04$), but was not associated with Y2 risk for hazardous drinking (IRR = 0.98, $p = .65$) at Y2 after accounting for the same alcohol outcome at Y1 and covariates.

Model for Perceived Neighborhood Disorder. As shown in Table 7, results demonstrated no significant interactions between race and neighborhood disorder on drinker status (ORs = 0.99 – 1.21, *p*s = .16 – .78) or risk for hazardous drinking (IRRs = 0.91 – 1.62, *p*s = .14 – .54) at Y2 after accounting for the same alcohol outcome at Y1 and covariates. After controlling for neighborhood disorder, Asian (OR = 0.28, $p < .01$) and Black (OR = 0.29, $p < .01$) adolescents were less likely to be drinkers than their White peers. Multiracial and White adolescents did not differ (OR = 0.72, $p = .45$) in terms of their risk for being drinkers at Y2. Race was not associated with Y2 risk for hazardous drinking (IRRs = 0.60 – 1.62, *p*s = .26 – .92). Neighborhood disorder was not independently associated with drinker status (OR = 0.87, $p = .22$) and risk for hazardous drinking (IRR = 0.91, $p = .39$) at Y2 after accounting for the same alcohol outcome at Y1 and covariates.

Combined Model for Both Neighborhood Disadvantage and Disorder. As shown in Table 8, results demonstrated no significant interactions of race with neighborhood disadvantage or perceived neighborhood disorder on drinking status (ORs = 0.88 – 1.08, *p*s = .13 – .89) and risk for hazardous drinking (IRRs = 0.95 – 1.33, *p*s = .16 – .81) at Y2 after accounting for the same alcohol outcome at Y1 and covariates. After controlling for other predictors in the model, Asian (OR = 0.35, $p = 0.03$) and Black (OR = 0.37, $p = .01$) adolescents were less likely to be drinkers at Y2 than Whites. Multiracial adolescents did not differ from White adolescents in

terms of their risk for being drinkers at Y2 (OR = 0.91, p = .84). Neighborhood characteristics at Y1 were not significantly associated with drinker status and risk for hazardous drinking at Y2 at Y2 after accounting for the same alcohol outcome at Y1 and covariates.

Ancillary Analyses. Ancillary analyses using the three individual ADUIT subscales (i.e., consumption, dependence symptoms and negative consequences) as outcomes yielded the same results as the main analyses using the overall sum score in terms of non-significant interactions of race with neighborhood disadvantages and disorders in both cross-sectional and prospective analyses (results are not shown).

Discussion

Few previous investigations examined the racial disparities in adolescent alcohol behaviors within the context of the neighborhood's structural socioeconomic disadvantage and the residents' perceived neighborhood disorder. The current study expanded the scant literature by examining the association of adverse neighborhood conditions (i.e., disadvantage and disorder) with adolescent alcohol behaviors and the degree to which these relationships differed between racial minority (i.e., Asian, Black, Multiracial) adolescents and White adolescents. The current study offered novel findings by employing a prospective design to model alcohol behaviors and hurdle models to simultaneously estimate distinct correlates of two alcohol behaviors (i.e. abstinence assessed as drinker status and hazardous drinking) within the same outcome measure. Inconsistent with the hypotheses, results from hurdle models demonstrated little evidence that neighborhood conditions are associated with adolescent alcohol behaviors differentially across racial groups. Neighborhood disadvantage was found to be prospectively associated with a lower likelihood of drinker status endorsement. An important finding indicated Multiracial adolescents did not differ from Whites in the likelihood of current drinker status

except when neighborhood disorder was not controlled at Y2. The racial differences in drinker status appear to be unrelated to neighborhood disadvantage and perceived neighborhood disorder. Overall, findings suggested that neighborhood disadvantage and disorder were unlikely to contribute to current drinker status and risk for hazardous alcohol use.

Racial Differences in the Association of Adverse Neighborhood Conditions with Adolescent Drinking Behaviors

Contrary to the hypotheses, cross-sectional and prospective associations between adverse neighborhood conditions (neither disadvantage nor disorder) and adolescent alcohol behaviors did not differ across the racial groups. Null findings may be explained by limited variability in neighborhood conditions within racial groups in the current study. The current study did not replicate the results from Fagan et al. (2013), which indicated that neighborhood disadvantage increased the likelihood of past-year alcohol use for Black adolescents. However, the bivariate correlations of the current study showed that both Asian and Black adolescents resided in more disadvantaged neighborhoods while White adolescents resided in more socioeconomically advantaged neighborhoods, and Multiracial adolescents did not show any associations with neighborhood adversity. Further, many of the census tracts recorded in the current study contain five or less participants, futher decreasing the probability that each racial group is well represented across all levels of adverse neighborhood conditions. Therefore, the absence of racial representation across various levels of neighborhood adversity may have led to the null findings of racial differences in the association between neighborhood conditions and adolescent alcohol use. A possible rememdy for future studies is to incorporate recruitment strategies that can ensure racially diverse samples across multiple levels of adverse neighborhood conditions.

Associations of Adverse Neighborhood Conditions with Adolescent Drinking Behaviors

Across all hurdle models, only one significant main effect of neighborhood conditions was found in that neighborhood disadvantage was associated with a lower likelihood of drinker status one year later. A majority of the previous studies on the association between neighborhood disadvantage and adolescent alcohol behaviors with similar disadvantage indices created from U.S. census data reported largely mixed findings in the associations (when interactions with race were not considered; Hawkins et al., 1992; N. Jackson et al., 2016; Snedker et al., 2009; Tobler et al., 2011). This divergence from existing literature may be due to the high concentration of Asian and Black adolescents residing in more disadvantaged neighborhoods in our sample. Consequently, the racial differences in drinker status, which have often been attributed to family and peer influences, are also reflected in the association between higher neighborhood disadvantage and lower drinker status endorsement rate. The largely null findings in the neighborhood-alcohol associations from the current studies are different than the results from adult studies, which found that neighborhood disadvantage and disorder increase alcohol use among adults (Algren et al., 2015). However, such relationships have not been consistently replicated in adolescent samples. Adolescent alcohol behaviors may be more strongly associated with proximal social environments such as their friends and family members; only as they grow older, their drinking behaviors may be associated with neighborhood environments (Chung et al., 2018; Nesi et al., 2017). Examining the neighborhood environment without consideration of proximal promotive factors may not be developmentally sensitive.

Alternatively, null neighborhood-alcohol associations may be explained by insufficient variability between and within neighborhoods to highlight differences within the current school district. Methodologists argued that a study design based on a single city or region can contain neighborhoods with too few participants to reliably estimate correlation within neighborhoods,

again underestimating differences between neighborhoods (Brooks-Gunn et al., 1997; Duncan et al., 1997). Consequently, the current study excluded the recommended multilevel methods by previous reviews on neighborhood research (Bernburg & Thorlindsson, 2005; N. Jackson et al., 2014). Without sufficient data from each census tract, random effects generated by the clustering could not be accounted for and many of the census tracts' characteristics appeared largely homogenous, thereby rendering the examination of between neighborhood differences difficult.

Racial Differences in Adolescent Drinking Behaviors

Consistent with limited emerging literature, Multiracial adolescents were more likely to use alcohol than monoracial minorities and demonstrated drinking at prevalence comparable to their White peers. Increased risk of using alcohol among Multiracial adolescents may be explained by unique identity considerations. Compared to their monoracial peers, multiracial adolescents' multifaceted racial heritage may expose them to greater frequency of discrimination and identity struggles that lead to more stress response (Sanchez et al., 2009; Shih & Sanchez, 2009). Stress stemming from racial discrimination and rejection based on identity have been linked to increased alcohol use among adolescents. Multiracial population growth has greatly exceeded monoracial populations (Jones & Bullock, 2012). Thus, multiracial adolescents may be at increased risk for drinking compared to their minority monoracial peers, suggesting the need to substantially expand the dearth of Multiracial adolescent alcohol research

Comparable racial disparities were not observed for hazardous drinking. That is, although Asian and Black adolescents were less likely than Whites to start drinking, racial groups did not differ in their risk for hazardous alcohol use. Current null findings may be explained by the fact that racial differences in risk for hazardous drinking may become apparent as adolescents get older. Because standard trajectory research demonstrates that risky drinking typically begins later

in the transition into emerging adulthood (Windle et al., 2005), it is possible that the current study of adolescents was not able to capture these emerging racial disparities. This hypothesis is supported by the fact that Black and Multiracial adolescents in this study showed more positive (although not significant) associations with risk for hazardous drinking compared to White adolescents, consistent with adult literature demonstrating relatively increased risk for drinking and associated consequences among racial minority groups (Caetano et al., 2014; Mulia et al., 2009). Future research is needed to investigate longer prospective follow-ups into late adolescence and emerging adulthood (with greater numbers of drinkers and problematic drinkers) to observe developmental trends of racial differences in hazardous drinking as they emerge over time.

Strengths and Limitations of the Current Study

The current study benefited from a prospective design, a racially diverse adolescent sample, integration of both neighborhood disadvantage and neighborhood disorder as two aspects of adverse neighborhood conditions, and the use of advanced statistical analytic strategies. The one-year prospective design modeled changes in alcohol outcomes over time as a function of exposures to adverse neighborhood conditions. Cross-sectional designs widely used in prior studies (e.g. Chen et al., 2012; Goings et al., 2018; K. F. Jackson & Lecroy, 2009) did not ascertain the temporal order of concurrently measured neighborhood predictors and alcohol outcomes. Findings from the current study could clarify the temporal effects of neighborhood conditions on adolescent alcohol behaviors, although observational correlations cannot offer causal inferences. The high percentage of Multiracial adolescents in the current dataset allowed for comparisons against monoracial groups (i.e. Asian, Black, White). Multiracial adolescents have been historically categorized as monoracial minorities (Fernandez, 1996; Root, 1992) or

dropped from analyses entirely (Willoughby & Hamza, 2011). Further, by investigating neighborhood disadvantage and disorder within the same models, this study was able to address residents' subjective experiences of their neighborhood environments in addition to using census data to represent structural socioeconomic disadvantages. Lastly, hurdle models offered the opportunity to accurately analyze zero-inflated data commonly encountered in substance use data obtained from adolescent and community samples (Buu et al., 2012), allowing for the estimation of both current drinker status and risk for hazardous alcohol use. Analyses tested correlates of initial abstinence (indicated by drinker status) and the risk factors for the subsequent escalation into hazardous drinking (Cambron et al., 2018; Pedersen et al., 2018).

Although the current study design had several methodological stregnths and novel approaches, results must be considered within the context of some limitaitons. First, the lack of variability in neighborhood census tracts limited the use of multilevel modeling to account for within-group correlation. Participants were students from a single urban school district such that the participants' home census tracts were more likely to be homogenous due to their proximity to each other in the same city. Underestimation of neighborhood-level effects can occur as geograpahical range is restricted (Leventhal & Brooks-Gunn, 2000). The lack of neighborhood characteriscs variability created significant barriers to detect any significant dfferences that may be due to the neighborhood environment. Second, the one-year follow-up assessment at mid-adolescence may not have fully capture potential raical disparities in the developemntal trends of drinking status and hazarous drinking risks. Second, the one-year follow-up assessment at mid-adolescence may not have fully chapture potential raical disparities in the developemntal trends of drinking status and hazarous drinking risks. Third, the relatively small proportion of key racial

minority groups (e.g., Multiracial; 17% of sample) may have precluded observation of racial differences in risks for hazardous alcohol use.

Implications for Preventions/Interventions

Results from the current study can potentially inform systems-level intervention efforts as well as supporting the need to improve the current understanding of Multiracial adolescents' alcohol use. Community-based interventions and outreach have shown promising results in reducing the rate of risky alcohol behaviors in adolescents (Fagan et al., 2011; Fagan et al., 2007). The null neighborhood associations suggest that community intervention programs may not need to be tailored to each neighborhood's poverty and levels of disorganization (Fagan et al., 2015). In particular, the findings in conjunction with current literature suggest that Multiracial adolescents have unique racial experiences and levels of alcohol use comparable to White adolescents. Clinicians will encounter more help-seeking Multiracial adolescents as their population continue to increase (Jones & Bullock, 2012; U.S. Census Bureau, 2010), therefore, a more informed understanding of Multiracial adolescents' alcohol use relative to other racial groups can offer a more holistic view of their behavioral health experiences.

Future Directions

Based on the results from the present study, several directions are of interest for future research. The largely null findings on neighborhood conditions across all models suggest that the neighborhood environment may not exert the same level of influences on adolescents as interpersonal, family, and school, highlighting the need to look beyond structural socioeconomic characteristics and perceived disorder. For example, adolescent alcohol use has been associated with parental monitoring and the changes in parenting practices as a function of race or neighborhood disadvantage/disorder (Carroll et al., 2016; Donaldson et al., 2016; Racz &

McMahon, 2011). Parental monitoring could be assessed separately as parental solicitation and knowledge to reflect the independent effects of the two constructs on adolescent behaviors (Stattin & Kerr, 2000). Furthermore, the current findings highlight that Multiracial adolescents continue to be a high-risk group due to lacking significant differences from White adolescents. Future research should make additional effort to include Multiracial groups separate from the monoroacial minorities. Other high risk but understudied groups, especially American Indian/Alaska Native and Native Hawaiian/Pacific Islander adolescents are especially at risk for problematic alcohol use (Friese et al., 2015; Wong et al., 2004). Future research can consider models that can explain the existing racial disparities (i.e., mediation). One such example is alcohol accessibility within a neighborhood. In addition to racial minorities' higher residential probability to reside in poorer neighborhoods. Disadvantaged neighborhoods also contain an abundance of cheap alcohol vendors and are thus associated with greater alcohol use frequency among adolescents from families of low socioeconomic status (Huckle et al., 2008).

Conclusion

The current study is one of the few adolescent alcohol studies that examined racial differences in prospective neighborhood-alcohol associations among adolescents. No evidence was found to show that the relationship between neighborhood conditions and adolescent alcohol behaviors differ across racial groups. Further, the current measures of neighborhood conditions did not appear to play a role in adolescent alcohol behaviors. Most importantly, the current study supported a growing body of research that suggest Multiracial adolescents to be a high-risk group for alcohol use. Further research to replicate or to clarify the unique ecological contexts that raise risk for multiracial adolescents are needed, and it is recommended that future research continue to refine developmentally appropriate ecological models.

Table 1
Means and Standard Deviations or Percentages of Study Variables as a Function of Race at Year 1 (Y1) and at Year 2 (Y2)

	Racial Groups (full sample)				
Variables (possible range)	All[a] (*N* = 386)	Asian (18%; *n* = 70)	Black (43%; *n* = 167)	Multiracial (16%; *n* = 63)	White (22%; *n* = 86)
AUDIT[b] at Y1					
Drinkers (%)	27%	22%	18%	35%	41%
Sum (0-40)	1.07 (3.02)	0.87 (2.85)	0.90 (3.24)	0.87 (1.86)	1.65 (3.39)
Consumption (0-12)	0.44 (1.03)	0.31 (0.93)	0.34 (0.98)	0.45 (0.92)	0.70 (1.16)
Dependence (0-12)	0.13 (0.76)	0.10 (0.52)	0.14 (0.95)	0.10 (0.47)	0.17 (0.71)
Consequences (0-16)	0.49 (1.85)	0.46 (1.83)	0.43 (2.01)	0.32 (1.02)	0.78 (2.03)
Neighborhood conditions at Y1					
Disadvantage at Y1 (%)	32% (12%)	37% (12%)	34% (11%)	30% (11%)	24% (10%)
Perceived disorder at Y1 (0-20)	8.38 (3.60)	8.04 (3.50)	8.95 (3.80)	8.81 (3.98)	7.23 (2.59)
Covariates					
Female sex (%)	56%	54%	56%	67%	52%
Age	15.98 (1.07)	15.41 (1.21)	16.09 (1.04)	15.95 (1.10)	15.71 (0.87)
Hispanic (%)	11%	3%	7%	38%	4%
	Racial Groups (non-attriters at Y2)				
Variables (possible range)	All (*N* = 345)	Asian (18%; *n* = 63)	Black (44%; *n* = 151)	Multiracial (16%; *n* = 55)	White (22%; *n* = 76)
AUDIT[b] at Y2					
Drinkers (%)	32%	24%	23%	38%	54%
Sum (0-40)	1.10 (2.60)	0.65 (1.49)	0.78 (2.41)	1.97 (3.14)	1.42 (2.87)
Consumption (0-12)	0.61 (1.20)	0.48 (1.02)	0.30 (0.80)	1.20 (1.62)	0.82 (1.43)
Dependence (0-12)	0.17 (0.75)	0.07 (0.25)	0.17 (0.90)	0.25 (0.71)	0.18 (0.75)
Consequences (0-16)	0.34 (1.10)	0.10 (0.35)	0.32 (1.12)	0.53 (1.39)	0.42 (1.12)
Neighborhood conditions at Y1					
Disadvantage at Y1 (%)	33% (11%)	36% (11%)	36% (11%)	26% (9%)	31% (10%)
Perceived disorder at Y1 (0-20)	8.30 (3.60)	7.90 (3.30)	8.90 (3.90)	7.10 (2.50)	8.80 (4.00)
Covariates					
AUDIT Sum Score at Y1	0.90 (2.70)	0.81 (2.15)	0.72 (2.98)	0.73 (1.51)	1.46 (3.14)
Female sex (%)	56%	56%	54%	65%	53%
Age at Y1	17 (1.10)	16.10 (1.29)	16.04 (1.02)	15.86 (1.10)	15.67 (0.89)
Hispanic (%)	10%	2%	7%	36%	4%

Note. *N* = 381 – 386 at Y1 due to missing data on perceived neighborhood disorder (*n* = 6) and AUDIT scores (*n* = 3), *N* = 342 – 345 at Y2 due to missing data in perceived neighborhood disorder (*n* = 3) and AUDIT scores (*n* = 1).
[a] Hawaiian/Pacific Islander and American Indian/Alaska Native racial groups were excluded at Y1 from analyses due to their small size (*n* = 10)
[b] AUDIT = Alcohol Use Disorder Identification Test

Table 2
Bivariate Correlations among Study Variables

Variable	Correlation Coefficients[a]									
	1	2	3	4	5	6	7	8	9	10
1. Asian race[b]	-	-								
2. Black race[b]	-	-	-							
3. Multirace[b]	-	-	-	-						
4. White race[b]	-	-	-	-						
5. Y1 AUDIT Sum[c]	-.04	-.04	-.03	.12*	-					
6. Y2 AUDIT Sum[c]	-.09	-.11*	.05	.18**	.28***	-				
7. Y1 Neighborhood disadvantage	.18***	.19***	-.06	-.34***	.05	-.14*	-			
8. Y1 Neighborhood disorder	-.04	-.14**	.05	.17**	.07	-.02	-.39***	-		
9. Female Sex (vs. Male)	.02	.01	-.10	.05	.05	.07	.05	-.04	-	
10. Age	.04	.09	-.02	-.14*	.23	.10	.08	-.03	.11	-
11. Hispanic	-.12*	-.10	.39***	.12*	-.07	-.07	-.02	-.02	-.03	.08

Note. $N = 381 – 386$ due to missing data in perceived neighborhood disorder ($n = 6$) and AUDIT scores ($n = 3$).
[a] Pearson's correlation coefficients are reported for two continuous variables; Spearman's coefficients (r_s) are reported for continuous and dichotomous variables; Phi coefficients (r_φ) are reported for two dichotomous variables.
[b] Correlation coefficients between racial groups were discarded due to data separation, the four race groups were dummy coded into four separate variables for the calculation of correlation coefficients; Native Hawaiian/Pacific Islander and American Indian/Alaska Native racial groups were be excluded from analyses due to their small size ($n = 9$).
[c] AUDIT = Alcohol Use Disorder Identification Test
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 3
Cross-Sectional Hurdle Model of Race-Neighborhood Disadvantage interactions at Y1 on Drinker Status and Hazardous Drinking at Y1

Hazardous Drinking at Y1 (Count Model)	*B(SE)*	*IRR*
Intercept	-0.73 (1.43)	0.48
Neighborhood disadvantage at Y1	-0.05 (0.04)	0.95
Racial group comparisons		
Asian (vs. White)	0.24 (0.69)	1.27
Black (vs. White)	0.77 (0.57)	2.16
Multiracial (vs. White)	-0.70 (0.67)	0.50
Interactions		
Asian (vs. White) X Neighborhood disadvantage	0.00 (0.07)	1.00
Black (vs. White) X Neighborhood disadvantage	0.10 (0.07)	1.11
Multiracial (vs. White) X Neighborhood disadvantage	0.11 (0.06)	1.12
Covariates		
Male sex	0.42 (0.39)	1.52
Age	0.14 (0.21)	1.15
Hispanic status	0.36 (0.88)	1.43
Log (Theta)	-2.10 (1.60)	0.12
Drinker Status at Y1 (Logistic Model)	***B(SE)***	***OR***
Intercept	-0.30 (0.32)	0.74
Neighborhood disadvantage at Y1	-0.02 (0.03)	0.98
Racial group comparisons		
Asian (vs. White)	-0.93 (0.44)*	0.40
Black (vs. White)	-1.17 (0.37)**	0.31
Multiracial (vs. White)	0.16 (0.43)	1.17
Interactions		
Asian (vs. White) X Neighborhood disadvantage	0.01 (0.04)	1.01
Black (vs. White) X Neighborhood disadvantage	-0.03 (0.03)	0.97
Multiracial (vs. White) X Neighborhood disadvantage	0.02 (0.04)	1.03
Covariates		
Male sex	-0.10 (0.25)	0.91
Age	0.44 (0.13)***	1.56
Hispanic status	-1.00 (0.47)*	0.37

Note. $N = 386$.
* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Table 4
Cross-Sectional Hurdle Model of Race-Neighborhood Disorder interactions at Y1 on Drinker Status and Hazardous Drinking at Y1

Hazardous Drinking at Y1 (Count Model)	*B(SE)*	*IRR*
Intercept	-0.17 (1.31)	0.85
Neighborhood disorder at Y1	0.09 (0.12)*	1.09
Racial group comparisons		
Asian (vs. White)	-0.46 (0.58)	0.63
Black (vs. White)	0.22 (0.47)	1.25
Multiracial (vs. White)	-1.42 (0.62)	0.24
Interactions		
Asian (vs. White) X Neighborhood disorder	-0.16 (0.20)	0.85
Black (vs. White) X Neighborhood disorder	0.03 (0.16)	1.02
Multiracial (vs. White) X Neighborhood disorder	0.05 (0.15)	1.05
Covariates		
Male sex	0.40 (0.40)	1.49
Age	0.09 (0.21)	1.09
Hispanic status	0.07 (0.92)	1.07
Log (Theta)	-2.04 (1.56)	0.13
Drinker Status at Y1 (Logistic Model)	***B(SE)***	***OR***
Intercept	-0.06 (0.28)	0.94
Neighborhood disorder at Y1	0.07 (0.09)	1.07
Racial group comparisons		
Asian (vs. White)	-1.24 (0.40)**	0.29
Black (vs. White)	-1.44 (0.33)***	0.24
Multiracial (vs. White)	-0.10 (0.40)	0.90
Interactions		
Asian (vs. White) X Neighborhood disorder	-0.04 (0.12)	0.96
Black (vs. White) X Neighborhood disorder	-0.12 (0.11)	0.88
Multiracial (vs. White) X Neighborhood disorder	-0.02 (0.11)	0.98
Covariates		
Male sex	-0.15 (0.26)	0.86
Age	0.46 (0.12)***	1.59
Hispanic status	-1.21 (0.50)*	0.30

Note. $N = 386$.
* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Table 5.
Cross-Sectional Hurdle Model of Race-Neighborhood Disadvantage and Disorder interactions at Y1 on Drinker Status and Hazardous Drinking at Y1

Hazardous Drinking at Y1 (Count Model)	*B (SE)*	*IRR*
Intercept	-0.60 (1.03)	0.55
Racial group comparisons		
Asian (vs. White)	0.41 (0.70)	1.50
Black (vs. White)	0.97 (0.58)	2.65
Multiracial (vs. White)	-0.64 (0.71)	0.53
Neighborhood characteristics		
Neighborhood disorder at Y1	0.20 (0.15)	1.22
Neighborhood disadvantage at Y1	-0.09 (0.05)	0.91
Interactions		
Asian (vs. White) X Neighborhood disorder	-0.31 (0.23)	0.74
Black (vs. White) X Neighborhood disorder	-0.11 (0.18)	0.90
Multiracial (vs. White) X Neighborhood disorder	-0.09 (0.23)	0.91
Asian (vs. White) X Neighborhood disadvantage	0.03 (0.07)	1.03
Black (vs. White) X Neighborhood disadvantage	0.13 (0.08)	1.14
Multiracial (vs. White) X Neighborhood disadvantage	0.11 (0.09)	1.12
Covariates		
Male	0.36 (0.39)	1.44
Age	0.19 (0.22)	1.21
Hispanic status	0.04 (0.90)	1.04
Log (Theta)	-1.66 (1.16)	0.19
Drinker Status at Y1 (Logistic Model)	*B (SE)*	*OR*
Intercept	-0.28 (0.34)	0.76
Racial group comparisons		
Asian (vs. White)	-0.97 (0.45) *	0.38
Black (vs. White)	-1.22 (0.38) *	0.29
Multiracial (vs. White)	0.11 (0.44)	1.11
Neighborhood characteristics		
Neighborhood disorder at Y1	0.13 (0.11)	1.14
Neighborhood disadvantage at Y1	-0.04 (0.03)	0.96
Interactions		
Asian (vs. White) X Neighborhood disorder	-0.09 (0.14)	0.92
Black (vs. White) X Neighborhood disorder	-0.15 (0.13)	0.86
Multiracial (vs. White) X Neighborhood disorder	-0.09 (0.14)	0.92
Asian (vs. White) X Neighborhood disadvantage	0.02 (0.05)	1.02
Black (vs. White) X Neighborhood disadvantage	-0.01 (0.04)	0.99
Multiracial (vs. White) X Neighborhood disadvantage	0.04 (0.05)	1.04
Covariates		
Male	-0.13 (0.26)	0.88
Age	0.49 (0.13) ***	1.63
Hispanic status	-1.20 (0.51) *	0.30

Note. $N = 386$.
* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Table 6
Prospective Hurdle Model of Race-Neighborhood Disadvantage interactions at Y1 on Drinker Status and Hazardous Drinking at Y2

Hazardous Drinking at Y2 (Count Model)	*B (SE)*	*IRR*
Intercept	0.16 (0.54)	1.17
Neighborhood disadvantage at Y1	-0.02 (0.04)	0.98
Racial group comparisons		
Asian (vs. White)	-0.44 (0.59)	0.65
Black (vs. White)	0.05 (0.49)	1.05
Multiracial (vs. White)	0.63 (0.54)	1.88
Interactions		
Neighborhood disadvantage X Asian (vs. White)	0.01 (0.05)	1.00
Neighborhood disadvantage X Black (vs. White)	-0.01 (0.05)	0.99
Neighborhood disadvantage X Multiracial (vs. White)	0.04 (0.05)	1.05
Covariates		
AUDIT at Y1	0.06 (0.05)	1.06
Male sex	0.39 (0.32)	1.47
Age at Y1	0.23 (0.18)	1.26
Hispanic status	-0.98 (0.61)	0.37
Log (Theta)	-0.72 (0.59)	0.49
Drinker Status at Y2 (Logistic Model)	***B (SE)***	***OR***
Intercept	-0.43 (0.37)	0.65
Neighborhood disadvantage at Y1	-0.07 (0.03) *	0.94
Racial group comparison		
Asian (vs. White)	-1.09 (0.49) *	0.34
Black (vs. White)	-0.99 (0.41) ***	0.37
Multiracial (vs. White)	-0.13 (0.48) *	0.88
Interactions		
Neighborhood disadvantage X Asian (vs. White)	0.07 (0.04)	1.08
Neighborhood disadvantage X Black (vs. White)	0.05 (0.04)	1.05
Neighborhood disadvantage X Multiracial (vs. White)	0.01 (0.04)	1.01
Covariates		
AUDIT at Y1	0.27 (0.07) ***	1.32
Male sex	-0.15 (0.27)	0.86
Age at Y1	0.36 (0.13) **	1.44
Hispanic status	-0.52 (0.49)	0.59

Note. $N = 345$.
* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Table 7.
Prospective Hurdle Model of Race-Neighborhood Disorder interactions at Y1 on Drinker Status and Hazardous Drinking at Y2

Hazardous Drinking at Y2 (Count Model)	*B (SE)*	*IRR*
Intercept	0.20 (0.53)	1.23
Neighborhood disorder at Y1	-0.09 (0.10)	0.91
Racial group comparisons		
Asian (vs. White)	-0.51 (0.52)	0.60
Black (vs. White)	0.39 (0.43)	1.48
Multiracial (vs. White)	0.48 (0.48)	1.62
Interactions		
Neighborhood disorder X Asian (vs. White)	0.23 (0.17)	1.26
Neighborhood disorder X Black (vs. White)	-0.10 (0.13)	0.91
Neighborhood disorder X Multiracial (vs. White)	0.20 (0.14)	1.23
Covariates		
AUDIT at Y1	0.08 (0.05)	1.08
Male sex	0.07 (0.34)	1.07
Age at Y1	0.18 (0.18)	1.20
Hispanic status	-1.43 (0.66) *	0.24
Log (Theta)	-0.92 (0.63)	0.40
Drinker Status at Y2 (Logistic Model)	*B (SE)*	*OR*
Intercept	-0.18 (0.31)	0.84
Neighborhood disorder at Y1	-0.14 (0.09)	0.87
Racial group comparisons		
Asian (vs. White)	-1.27 (0.43) **	0.28
Black (vs. White)	-1.22 (0.35) **	0.29
Multiracial (vs. White)	- 0.33 (0.42)	0.72
Interactions		
Asian (vs. White) X Neighborhood disorder	0.19 (0.13)	1.21
Black (vs. White) X Neighborhood disorder	0.19 (0.11)	1.21
Multiracial (vs. White) X Neighborhood disorder	-0.01 (0.13)	0.99
Covariates		
AUDIT at Y1	0.31 (0.08) **	1.36
Male sex	-0.24 (0.27)	0.79
Age at Y1	0.35 (0.13) **	1.42
Hispanic status	-0.53 (0.48)	0.59

Note. $N = 345$.
* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Table 8
Prospective Hurdle Model of Race-Neighborhood Disadvantage and Disorder interactions at Y1 on Drinker Status and Hazardous Drinking at Y2

Hazardous Drinking at Y2 (Count Model)	*B (SE)*	*IRR*
Intercept	0.30 (0.51)	1.35
Racial group comparisons		
Asian (vs. White)	-0.53 (0.58)	0.59
Black (vs. White)	0.05 (0.48)	1.05
Multiracial (vs. White)	0.34 (0.55)	1.40
Neighborhood characteristics		
Neighborhood disorder at Y1	-0.10 (0.14)	0.91
Neighborhood disadvantage at Y1	0.01 (0.05)	1.01
Interactions		
Asian (vs. White) X Neighborhood disorder	0.23 (0.19)	1.25
Black (vs. White) X Neighborhood disorder	-0.05 (0.15)	0.95
Multiracial (vs. White) X Neighborhood disorder	0.29 (0.20)	1.33
Asian (vs. White) X Neighborhood	-0.01 (0.06)	0.99
Black (vs. White) X Neighborhood disadvantage	-0.02 (0.06)	0.98
Multiracial (vs. White) X Neighborhood disadvantage	-0.04 (0.07)	0.96
Covariates		
AUDIT at Y1	0.09 (0.05)	1.09
Male	0.27 (0.32)	1.31
Age at Y1	0.17 (0.18)	1.18
Hispanic status	-1.18 (0.61)	0.31
Log (Theta)		
Drinker Status at Y2 (Logistic Model)	***B (SE)***	***OR***
Intercept	-0.44 (0.37)	0.64
Racial group comparisons		
Asian (vs. White)	-1.04 (0.50) *	0.35
Black (vs. White)	-1.00 (0.41) *	0.37
Multiracial (vs. White)	-0.09 (0.48)	0.91
Neighborhood characteristics		
Neighborhood disorder at Y1	0.01 (0.13)	1.01
Neighborhood disadvantage at Y1	-0.07 (0.04)	0.93
Interactions		
Asian (vs. White) X Neighborhood disorder	0.02 (0.16)	1.02
Black (vs. White) X Neighborhood disorder	0.05 (0.14)	1.05
Multiracial (vs. White) X Neighborhood disorder	-0.13 (0.16)	0.88
Asian (vs. White) X Neighborhood disadvantage	0.08 (0.05)	1.08
Black (vs. White) X Neighborhood disadvantage	0.04 (0.04)	1.04
Multiracial (vs. White) X Neighborhood disadvantage	0.04 (0.05)	1.04
Covariates		
AUDIT at Y1	0.30 (0.08) **	1.34
Male	-0.16 (0.27)	0.85
Age at Y1	0.37 (0.13) **	1.45
Hispanic status	-0.47 (0.49)	0.63

Note. $N = 345$.
* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

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Vita

NAME OF AUTHOR: Jin Zhao

CONTACT INFORMATION:
430 Huntington Hall,
Syracuse, New York 13244

GRADUATE AND UNDERGRADUATE SCHOOLS ATTENDED:
Syracuse University, Syracuse, NY
Teacher College, Columbia University, New York, NY
Arcadia University, Glenside, PA

DEGREES AWARDED:
Master of Arts, Psychology in Education, 2017, Teachers College, Columbia University
Bachelor of Arts, Psychology, 2013, Arcadia University