Alcohol Use Subgroups among Rural Middle School Students: The Impact of Community Violence Exposure

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ALCOHOL USE SUBGROUPS AMONG RURAL MIDDLE SCHOOL STUDENTS:
THE IMPACT OF COMMUNITY VIOLENCE EXPOSURE

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science
at Virginia Commonwealth University

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# Table of Contents

Acknowledgements ................................................................................................................................. ii  
List of Tables ........................................................................................................................................ v  
List of Figures ......................................................................................................................................... vii  
Abstract ................................................................................................................................................ viii  
Introduction ........................................................................................................................................... 1  
Literature Review ................................................................................................................................. 3  
  Early Adolescents’ Alcohol Use ........................................................................................................... 3  
  Developmental Period ......................................................................................................................... 3  
  Prevalence of Alcohol Use during Early Adolescence ........................................................................ 4  
  Adverse Outcomes Associated with Adolescent Alcohol Use .............................................................. 5  
  Patterns of Adolescent Alcohol Consumption ..................................................................................... 7  
Stress-Coping Model of Adolescent Alcohol Use ................................................................................ 14  
Community Violence Exposure and Adolescents’ Alcohol Use ............................................................ 16  
  Alcohol Use Frequency ....................................................................................................................... 18  
  Alcohol Use Initiation ........................................................................................................................ 21  
  Sex and Gender Differences .............................................................................................................. 25  
  Youth in Rural Communities .............................................................................................................. 26  
  Nonviolent Stressors .......................................................................................................................... 28  
Statement of the Problem ..................................................................................................................... 29  
  The Current Study ............................................................................................................................. 32  
Methods ............................................................................................................................................... 34  
  Participants and Study Setting ............................................................................................................ 34  
  Procedures .......................................................................................................................................... 35  
  Measures ............................................................................................................................................ 35  
  Data Analyses ...................................................................................................................................... 39  
Results ................................................................................................................................................... 45  
  Descriptive Statistics ........................................................................................................................ 45  
  Latent Class Enumeration ................................................................................................................... 47  
     Progressive Elaboration Procedure .................................................................................................. 47  
     Differential Item Functioning .......................................................................................................... 57  
     Final Model Incorporating DIF .......................................................................................................... 59
List of Tables

1. Proportion of the Sample Endorsing the Frequency Categories for Each Indicator …… 45
2. Descriptive Statistics for Measures of Exposure to Violence and Nonviolent Life Stressors ………………………………………………………………………… 45
3. Correlations among Independent Variables ……………………………………………… 46
4. Model Fit Indices for K-Class Models with Trichotomous Indicators …………………… 47
5. Model Fit Indices for K-Class Models that Emerged from the Progressive Elaboration Analyses …………………………………………………………………….. 53
6. Final Class Counts and Proportions for K-Class Models Based on Most Likely Latent Class Membership ………………………………………………………………… 54
7. Conditional Item Response Probabilities within the Full Sample and the Five-Class Model of Alcohol Use ………………………………………………………… 55
8. Conditional Item Response Probabilities within the Full Sample and the Five-Class Model of Alcohol Use Accounting for DIF ………………………………………… 59
9. Odds Ratios for the Effects of Violent and Nonviolent Stressor Variables on Class Membership ………………………………………………………………………… 71
10. Odds Ratios for the Unique Effects of Variables Representing Exposure to Stressors on Class Membership …………………………………………………………… 79

A-1. Model Fit Indices for the Five-Class Model of Alcohol Use with Progressive Cut Points………………………………………………………………………… 121

A-2. Model Comparisons for Stepwise DIF Testing by Sex with the Five-Class Model of Alcohol Use ……………………………………………………………………… 123
A-3. Model Comparisons for Stepwise DIF Testing by Grade with the Five-Class Model of Alcohol Use ................................................................. 124

A-4. Model Comparisons for Stepwise DIF Testing by Racial-Ethnic Group with the Five-Class Model of Alcohol Use ...................................................... 125
List of Figures

1. Graphical Representation of the Latent Class Regression Model with Covariates and Independent Variables ................................................................. 52
2. Proportion of Adolescents in Each Alcohol Use Class by Sex ...................... 64
3. Proportion of Adolescents in Each Alcohol Use Class by Grade .................. 65
4. Proportion of Adolescents in Each Alcohol Use Class by Racial-Ethnic Background … 66
5. Probability of Membership in Each Alcohol Use Class at Different Levels of Witnessing Violence .......................................................... 72
6. Probability of Membership in Each Alcohol Use Class at Different Levels of Physical Victimization .......................................................... 73
7. Probability of Membership in Each Alcohol Use Class at Different Levels of Environmental Stressors ........................................................ 74
8. Probability of Membership in Each Alcohol Use Class at Different Levels of Unfair Situations .......................................................... 75
9. Probability of Membership in Each Alcohol Use Class at Different Levels of Peer Provocation .......................................................... 76
10. Probability of Membership in Each Alcohol Use Class at Different Levels of Victimization across Sex ......................................................... 83
Abstract

ALCOHOL USE SUBGROUPS AMONG RURAL MIDDLE SCHOOL STUDENTS:
THE IMPACT OF COMMUNITY VIOLENCE EXPOSURE

By Courtney B. Dunn, B.A.

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at Virginia Commonwealth University

Virginia Commonwealth University, 2021

Director: Albert D. Farrell
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A substantial portion of early adolescents initiate alcohol use. This represents a significant public health concern due to its association with a variety of adverse consequences. Although person-centered analytic approaches such as latent class analysis have been used to describe heterogeneity in adolescents’ alcohol use, most prior studies have focused on high school or older samples. This may obscure patterns of alcohol use that emerge during early adolescence. The current study identified and described subgroups of adolescents based on their alcohol use in a racially diverse sample of rural middle school students. Because research and theory indicate that exposure to stressors relates to adolescent alcohol use, this study also examined the extent to which community violence exposure related to membership in alcohol use subgroups. Latent class analysis identified five subgroups of adolescents who differed based on their lifetime use and past month use of alcohol: Abstainers (56.9%), Initiators of wine and beer (12.9%), Moderately frequent wine and beer users (11.7%), Moderately frequent wine, beer, and liquor users who got drunk (10.9%), and Highly frequent wine, beer, and liquor users who got drunk (7.7%). Probability of class membership varied based on participant sex, grade, and racial-ethnic background. Results of multinomial logistic regression analyses indicated that
adolescents with more frequent exposure to community violence and unfair life stressors had an increased risk of being in subgroups characterized by more severe alcohol use. Witnessing violence and physical victimization were each associated with alcohol use class membership after controlling for nonviolent stressors and peer pressure for substance use. Future research should continue to examine heterogeneity in adolescents’ alcohol use and its relation with risk and protective factors using the latent class analysis framework. Longitudinal research is needed to examine exposure to stressors and changing patterns of alcohol use throughout early adolescence and mechanisms that explain these relations to inform prevention efforts.
Alcohol Use Subgroups among Rural Middle School Students: The Impact of Community Violence Exposure

Early adolescence is an important age group for the study of alcohol use. Risk for onset of alcohol use begins around ages 10 to 12 and increases substantially throughout adolescence (Forman-Hoffman et al., 2017; Wagner & Anthony, 2002), with 15 to 25% of adolescents initiating alcohol use before or during middle school (Johnston et al., 2021; Kann et al., 2018). Alcohol use at this age is associated with an increased risk of experiencing adverse short- and long-term consequences, including problem behaviors and substance use disorders (Boden & Fergusson, 2011; Kann et al., 2018; Magid & Moreland, 2014). The consequences that result from adolescents’ alcohol use vary based on age of onset, frequency of use, and the amount of alcohol typically consumed (Kuntsche et al., 2013; K. D. Thompson et al., 2012). It is therefore vital to understand patterns with which adolescents use alcohol to guide the development of effective prevention efforts.

A better understanding of typical alcohol use patterns that emerge during early adolescence will enable researchers to identify individuals at the highest risk for problematic alcohol use and adverse outcomes and guide the development of targeted intervention efforts. Whereas researchers have typically used continuous or binary items to measure alcohol use, person-centered approaches such as cluster and latent class analysis offer a strategy to capture heterogeneity in overall severity of adolescents’ alcohol use by identifying unique subgroups based on multiple indicators of alcohol use (e.g., frequency, quantity). Indeed, studies using latent class analysis have described three to four subgroups of adolescent alcohol users that vary in severity of overall use (e.g., Donovan & Chung, 2015; Gohari et al., 2020). Person-centered approaches can also be combined with variable-centered approaches (i.e., regression) to examine
relations between risk and protective factors and adolescents’ patterns of alcohol use. Although most prior research has solely relied on variable-centered approaches (i.e., regression) to examine relations between variables, combined person- and variable-centered approaches (i.e., latent class regression) can examine how associations with related factors vary based on adolescents’ overall severity of alcohol use.

Research is needed that identifies factors that increase the likelihood that early adolescents will progress to more severe alcohol use. Both theory and research have identified exposure to violent environmental stressors as a risk factor for alcohol use. More specifically, stress-coping theory posits that adolescents consume alcohol as a coping strategy to reduce negative emotions or increase positive emotions when experiencing distress (Lazarus & Folkman, 1984; Wills & Filer, 1996). A significant body of research has established a positive relation between adolescents’ community violence exposure and the initiation of alcohol use (e.g., Kilpatrick et al., 2000; Mrug & Windle, 2009; Ramos-Olazagasti et al., 2017; Sullivan et al., 2004) and elevated frequency of alcohol use (Goldstick et al., 2019; Pinchevsky, Wright, et al., 2013; M. P. Thompson et al., 2008; Zimmerman & Kushner, 2017). Several studies suggest that associations between alcohol use and community violence exposure might vary across different types of exposure, such as witnessing violence and physical victimization (e.g., Goldstick et al., 2019; Pinchevsky, Wright, et al., 2013). Additional research is needed to understand the unique associations of exposure to witnessing violence, physical victimization, and nonviolent stressors with adolescents’ alcohol use.

Two primary aims of this study were to use a person-centered analytic approach to identify and describe unique subgroups of middle school students based on their patterns of alcohol use in their lifetime and the past month, and examine whether alcohol use patterns varied
based on individual characteristics. Because the prevention of adolescents’ alcohol use also relies on the ability to identify and understand risk and resilience factors, a third aim was to determine how exposure to community violence relates to membership in alcohol use subgroups. In the following sections I review the literature on early adolescents’ alcohol use and person-centered approaches to studying alcohol consumption. I then review the empirical research on the association between community violence exposure and alcohol use. Finally, I discuss limitations of prior research and how the present study provides novel information about subgroups of early adolescents’ alcohol use and their relation with community violence exposure. This provides the basis for the current study, which (a) identified subgroups of early adolescent alcohol users, (b) examined relations between individual characteristics and subgroup membership, and (c) examined relations between exposure to community violence and nonviolent stressors and subgroup membership.

**Literature Review**

**Early Adolescents’ Alcohol Use**

*Developmental Period*

Early adolescence, occurring between ages 10 to 14, is a critical developmental stage that presents a heightened risk for experimentation with alcohol and other drugs. During this period the adolescent experiences biological, psychological, and social changes and must gradually attain skills to prepare them for the transition into young adulthood. This normative pattern of change also increases the propensity for substance use through social behavior, risk-taking, and pursuit of new reinforcers. Adolescents typically begin to distance themselves from their primary caregivers and affiliate more closely with peer groups, making peers the most important reinforcers of adolescent behavior (Spear, 2000). Due to this heightened peer influence, an
adolescent whose peers use substances is more likely to engage in substance use. In addition, neural development during puberty, chiefly the restructuring of the brain’s dopaminergic system, produces an increase in sensation-seeking, reward sensitivity, and a heightened response to risk-taking (Caudle & Casey, 2013; Spear, 2000; Steinberg, 2008). Although these behavioral changes are developmentally adaptive because they facilitate learning new skills and increasing autonomy, the heightened preference toward risk-taking, paired with an underdeveloped cognitive control system, makes adolescents more vulnerable to initiation of alcohol and drug use and progression to heavier levels of consumption (Steinberg, 2008).

**Prevalence of Alcohol Use during Early Adolescence**

Although overall trends indicate declining rates of alcohol use among adolescents in the United States (U.S.) since the 1980s, recent population-based studies find that a substantial portion of adolescents continue to initiate alcohol use before or during their middle school years (Johnston et al., 2021; Kann et al., 2018). Monitoring the Future is an annual survey of students in grades 8, 10, and 12 that measures substance use and related factors (Johnston et al., 2021). In 2020, 25.6% of eighth grade students reported drinking alcohol in their lifetime. A second U.S. population-based survey is the Youth Risk Behavior Survey, which asks respondents in grades 9 through 12 about their alcohol and drug use before age 13 years (i.e., 7th grade). Survey results from 2017 found that 15.5% of students first drank more than a few sips of alcohol before they were 13 years old (Kann et al., 2018). Both studies have large representative U.S. samples and long-term data collection that allows for identification of age and cohort effects. However, these studies do not collect prospective data from participants younger than eighth grade or ninth grade and do not ask for the age at first consumption.
Two population-based studies that collected data from community-based samples have been used to identify risk periods for substance use initiation. The National Comorbidity Survey is representative of the U.S. population between ages 15 and 54. Survival analyses of data from the 1990 to 1992 National Comorbidity baseline survey indicated that the risk for onset of alcohol use increased sharply beginning at age 10, rising from about 2% at age 10 years to 15% by age 15 years (Wagner & Anthony, 2002). Forman-Hoffman and colleagues (2017) used National Survey of Drug Use and Health cross-sectional data from 87,470 12- to 14-year-olds to examine prevalence of alcohol initiation among adolescents between 2004 and 2013. Approximately 13.9% reported having used alcohol in their lifetime, with rates of past-year initiation growing significantly with age. The mean prevalence of past-year alcohol initiation more than doubled between age 12 and 13 years from 5% to 12.6% and increased to over 24% among 14-year-olds. This indicates that early adolescence represents a critical period for initiation of alcohol use and should be targeted by prevention efforts.

**Adverse Outcomes Associated with Adolescent Alcohol Use**

Alcohol and drug use among adolescents is considered one of the leading causes of death, disease, and social problems among youth and adults living in the U.S. (Kann et al., 2018). A review of the literature by Boden and Fergusson (2011) concluded that adolescents who consume alcohol are more likely to experience accidents, including pedestrian accidents, falls, drowning, burns, crush injuries, and injuries from fighting. More frequent alcohol use during adolescence is also associated with an increase in risky sexual behavior and a heightened risk for developing sexually transmitted infections. Adolescents’ alcohol use may be related to increased risk for social and legal problems. One study of adolescents in 38 countries found that those who initiated drinking and heavy alcohol use at an early age were more likely to engage in other
problem behaviors at age 15, including drug use, physical fighting, and low academic performance (Kuntsche et al., 2013). In accordance with gateway theory, youth who initiate alcohol use are more likely to progress to other licit (e.g., tobacco) and illicit drug use (e.g., cannabis, cocaine; Ginzler et al., 2003; Johnston et al., 2006; Kandel et al., 1992; Maldonado-Molina & Lanza, 2010). In the long-term, early age of alcohol onset is related to dangerous behavior, such as alcohol-impaired driving and unintentional injury (Boden & Fergusson, 2011), and more frequent occupational, relationship, and legal problems as a result of alcohol use during young adulthood (Flory et al., 2004; Griffin et al., 2010; Nguyen-Louie et al., 2017). These behaviors may co-occur due to a genetic disposition for difficulty with self-regulation and impulsivity. A large body of literature has identified a common genetic etiology for substance use and other risk behaviors (Barr & Dick, 2020). However, genetic influences on alcohol use become stronger with age, such that early adolescents are more influenced by their environment, whereas late adolescents and adults are more influenced by genetics (Barr & Dick, 2020).

There is robust evidence that early substance initiation is a predictor of long-term substance-related problems. In one population-based study, more than 10% of adolescents who initiated alcohol use between age 12 and 14 met criteria for an alcohol use disorder within one year (Forman-Hoffman et al., 2017). Youth who initiate alcohol at an early age are more likely to continue using alcohol as adults, use alcohol heavily, and are at a heightened risk of developing alcohol and other substance use disorders (Hawkins et al., 1997; Hingson et al., 2006; Liang & Chikritzhs, 2013; Magid & Moreland, 2014). The estimated yearly costs associated with health care, lost work productivity, and crime due to excessive alcohol use total upwards of 249 billion dollars in the U.S. (Sacks et al, 2010). Due to these various negative physical and psychological
outcomes for the individual, and societal costs, early adolescents’ alcohol use is a crucial public health concern.

**Patterns of Adolescent Alcohol Consumption**

Although early alcohol use has been tied to high-risk and health-compromising outcomes, recent evidence suggests that age at first alcohol consumption may not be the best way to identify adolescents at the highest risk for adverse outcomes. In a study of 15-year-olds, age of first drunkenness was a stronger predictor of problem behaviors (e.g., other drug use, violence, low academic performance) than age of alcohol initiation, suggesting that early drinking onset has little impact on subsequent problem behavior unless there is a transition to drunkenness (Kuntsche et al., 2013). Further, being drunk during their first time drinking alcohol significantly increased the likelihood of subsequent problem-drinking among a predominantly White sample of adolescents (Warner et al., 2007). Together, these findings suggest that attempts to assess severity of alcohol use should consider the experience of drunkenness.

Other research indicates that frequency and amount of consumption among adolescents are key indicators of potential for harm. Using a community-based sample of Canadian youth, one study found that the likelihood of engaging in alcohol-related risk behaviors (e.g., drinking and driving, polysubstance use, failure to use sexual protection) began increasing significantly when consumption levels reached two drinks per occasion or drinking more than once per week (K.D. Thompson et al., 2012). Additionally, among a U.S. population-based sample of adolescents aged 12 to 14, a large percentage of those who initiated use in the past year reported continued alcohol use (40%) and heavy episodic drinking (i.e., binge drinking; 18%) in the past month (Forman-Hoffman et al., 2017). Over 10% of early adolescent alcohol initiators in this sample progressed to an alcohol use disorder within one year. It is likely that there is wide
variability across adolescents in the quantity of alcohol consumed and progression to more frequent and heavier levels of use. This variability may be missed in analyses that rely on a single measure of alcohol use. Methods and analytic approaches that consider multiple alcohol use behaviors (i.e., initiation age, drunkenness, frequency of use) as markers of adolescents’ overall severity of alcohol use would make a meaningful contribution to the current conceptualization in the literature.

Person-centered approaches may be particularly advantageous to the study of adolescent substance use. Person-centered analyses, such as cluster analyses and latent class analyses (LCA), organize a population into subgroups of individuals with similar patterns of responses on a set of indicator variables (Lanza & Cooper, 2016). These analyses assume that an underlying or latent variable explains the similarities between individuals’ responses. This method has been used by researchers to explain heterogeneity in alcohol use behaviors by identifying classes of individuals with similar responses on reports of alcohol use and associated behaviors. A literature search identified several studies that have used person-centered analyses to examine patterns of alcohol use in adolescent samples.

Stewart and Power (2002) examined drinking patterns in a community-based sample of students from a large metropolitan school district in the Southwest U.S.. A cluster analysis found eight clusters of high school students based on 19 continuous indicators of alcohol consumption across social contexts: light drinkers (26.4%), drinkers with parents (8.7%), drinkers at family occasions (5.9%), date drinkers (17.1%), moderate-friend drinkers (41.2%), party drinkers (7.9%), outdoor drinkers (11.1%), and heavy multiple-context drinkers (8.7%). The authors summarized these context-driven clusters into three more broadly defined groups. Whereas normative drinkers (light, parent, family occasion, moderate-friend, and party drinkers) drank in
developmentally normative contexts in light-to-moderate amounts, *problem drinkers* (*heavy multiple-context drinkers*) drank more frequently and in heavier amounts in risky contexts, and *at-risk drinkers* (*date, outdoor drinkers*) consumed alcohol frequently and in the largest quantities. Group membership was associated with psychosocial outcomes, such that *heavy multiple-context drinkers* exhibited the highest levels of problem behavior and drinking consequences and the lowest levels of self-esteem.

Previous studies using LCA have differentiated subgroups based on various items, including drinking frequency, heavy drinking frequency, drunkenness frequency, and typical quantity of alcohol consumed on a drinking occasion. Several studies have also included alcohol-related problems and consequences of alcohol use as indicators. For example, Reboussin et al. (2006) identified subgroups of underage alcohol use among 4,056 16-to-20-year-olds who reported recent alcohol use during a national cross-sectional telephone survey. Results of an LCA with 12 binary indicators of regular drinking, binge drinking, drunkenness, and alcohol-related problems (e.g., drunk driving, physical, social problems) supported a three-class solution. The largest class was *nonproblem drinkers* (43%), which had a very low prevalence of any drinking or consequences. *Risky problem drinkers* (30%) were heterogeneous in their reporting of drinking and drunkenness, but commonly experienced headaches or hangovers. Finally, nearly all *regular problem drinkers* (27%) reported binge drinking, getting drunk monthly, and experiencing headaches or hangovers. No other alcohol-related problems (i.e., drunk driving, passing out, social consequences), were consistently reported in any class. Past substance use (i.e., cigarette use, marijuana use, and early onset drinking) was associated with increased risk of being a *risky problem drinker* or *regular problem drinker* compared with being a *nonproblem*
drinker. This sample was predominantly White and middle socioeconomic status, so results must be interpreted bearing in mind this limitation.

Two studies examined alcohol use patterns using data from the population-based National Longitudinal Study of Adolescent Health (Add Health; Dauber et al., 2009; Donovan & Chung, 2015). Dauber et al., (2009) used Add Health data from African American and White female adolescents in grades 7 through 12 to identify subgroups based on 18 three- and four-category indicators of alcohol use and associated problems. Among White female adolescents (N=2,126) they found four unique subgroups: abstainers (50%), experimenters (21%), moderate drinkers (20%) and heavy drinkers (9%). Experimenters were likely to drink less than once per month in the past year and report no consequences of drinking. Moderate drinkers drank once per month or more, two or more drinks, and got drunk less than once per month, but had no alcohol-related problems. In contrast, heavy drinkers typically consumed four or more drinks per occasion and got drunk more than once per month in the past year. They often experienced hangovers but did not consistently report other alcohol problems. Among African American female adolescents (N = 822), three latent classes were identified. Similar to the results for White adolescents, abstainers (68%) and experimenters (23%) were the largest classes. African American experimenters drank less than once per month and never drank heavily or got drunk. The third class among African American female adolescents was problem drinkers (8.4%) who were more likely to drink more than once per month, consume four or more drinks per occasion, and experience hangovers. These results indicated that White and African American female adolescents quantitatively and qualitatively differed in their patterns of alcohol consumption, with White adolescents demonstrating overall higher-severity patterns of alcohol use.
Using the full Add Health sample with both male and female participants in grades 7 through 12, Donovan and Chung (2015) conducted an LCA with five variables of alcohol use (i.e., lifetime, past year frequency, usual intake, drunkenness frequency, quantity) and one variable of negative consequences. They used a “progressive elaboration” approach to determine whether three- or four-category indicators improved upon the fit of binary indicators that resulted in the selection of two binary indicators, three trichotomous indicators, and one indicator with four categories. The researchers then used a split-sample cross-validation approach to confirm this model in the second half of their sample. They found that a four-class solution was the best fit to the data. The latent classes included abstainers (55.2%) who had never consumed alcohol, low-intake drinkers (17.1%) who drank less than two days per month and never drank heavily or got drunk, non-problem drinkers (21.7%) who drank less than two days per month and got drunk and drank heavily, and problem drinkers (6.1%) who drank weekly or more in high volumes and were the only group that suffered consequences from their drinking.

Three additional studies using LCA examined alcohol use patterns among adolescents living in other countries. In a sample of Canadian high school students, Gohari et al. (2020) conducted an LCA with three- and four-category indicators of alcohol consumption frequency, binge drinking frequency, and age of alcohol initiation. They found four distinct classes: non-drinkers (44.2%), light drinkers (41.8%), regular drinkers (11.1%), and heavy drinkers (2.9%). Whereas light drinkers consumed alcohol up to three times per month, regular drinkers typically drank one to three times per week. Both subgroups were heterogeneous in their frequency of binge drinking but were unlikely to binge drink on a weekly basis. Heavy drinkers drank three or more times per week, binge drank more than once per week, and initiated alcohol use before age 14. Another study identified four subgroups of drinking based on seven binary indicators of
alcohol use and alcohol-related problems among high-school-aged youth in New Zealand: low risk (55%), moderate-risk (13%), high-risk (20%), and very high-risk (13%; Jackson et al., 2014). Whereas low-risk youth endorsed no alcohol use, other classes were all likely to typically drink five or more drinks. High-risk and Very-high risk classes were also characterized by binge drinking in the past four weeks, and the Very-high risk class reported engaging in risky behavior when drinking. Similarly, Wells et al. (2004) used four-category indicators in their LCA of drinking patterns among 16-year-old New Zealand youth. The four indicators included alcohol use frequency, typical amount of consumed, largest amount consumed, and alcohol-related problems. They selected a four-class model consisting of no alcohol use (24%), less than monthly drinking in the lowest quantities (i.e., 1-29 ml; 39%), monthly drinking in moderate quantities (i.e., 30-89 ml; 29%), and drinking monthly to weekly in the highest quantities (i.e., 90+ ml; 8%). Given differences in the legal drinking age (e.g., 18 vs 21) and alcohol use norms between these countries and the U.S., these patterns of alcohol use may not generalize to adolescents living in the U.S..

There is evidence that individual characteristics may impact latent class membership. Several of the studies reviewed found that male adolescents are more likely than female adolescents to belong to latent classes characterized by more frequent and higher levels of alcohol consumption. In a study of 16- to 20-year-olds in the U.S., male youth compared with female youth had a greater likelihood of membership in the problem drinker classes than the nonproblem drinker classes, suggesting that male adolescents were more likely to binge drink, get drunk, and experience hangovers (Reboussin et al., 2006). Donovan and Chung (2015) also found that male adolescents were more likely than female adolescents to be problem drinkers. Similar results were found among high school students in New Zealand (Jackson et al., 2014).
and Canada (Gohari et al., 2020). Moreover, when Khan et al., (2014) enumerated separate latent classes for male and female youth ages 11 through 21 years, they identified more classes of male youth with high probabilities of frequent and heavy drinking than those of female youth.

Several studies have examined differences in class membership based on age or grade. Most have found that younger adolescents were more likely to abstain from alcohol use (e.g., Dauber et al., 2009; Donovan & Chung, 2015) or be in a light or low risk drinking subgroup (e.g., Gohari et al., 2020; Jackson et al., 2014; Reboussin et al., 2006). These results correspond with prevalence estimates, which also show an increasing prevalence of alcohol use with age (Johnston et al., 2021). However, these age differences often involve comparisons between large age ranges, such as early versus middle to late adolescents (e.g., Dauber et al., 2009). More research is needed that examines age differences in patterns of alcohol use across shorter periods of time during early adolescence to understand how alcohol use progresses during this critical developmental period.

Prior studies have also identified differences in alcohol use subgroups based on race and ethnicity. As previously described, Dauber et al. (2009) identified four classes of alcohol use among White female adolescents and three classes among African American female adolescents. African American female adolescents were more likely to be abstainers and nearly all (91%) were either abstainers or experimenters. Khan et al. (2014) also enumerated separate latent classes for White, Latinx, and African American youth between ages 11 and 21. They found that White and Hispanic youth in heavy drinking classes more consistently endorsed drinking frequently and in greater volumes than African American youth. Other studies have found that African American adolescents were more likely to abstain from alcohol use (Donovan & Chung, 2015; Donovan & Molina, 2013), whereas White youth were more likely to engage in
problematic drinking (Donovan & Chung, 2015; Stewart & Power, 2002). These patterns also reflect those seen in national surveys (Johnston et al., 2018). More research is needed to better understand potential differences in drinking patterns among adolescents of different racial-ethnic backgrounds.

Although some researchers have identified latent classes based on the amount of alcohol consumed (e.g., light versus heavy drinkers), others have defined classes based on risk to the youth (e.g., nonproblem versus problem drinkers). Further, the cutoffs that designate various levels of consumption, both in frequency and amount, have varied across prior research. Despite these inconsistencies, most studies have found support for a three- or four-class solution with subgroups that differ in their frequency of alcohol consumption, heavy drinking, and drunkenness. Typically, only subgroups representing the most frequent or heaviest quantities of alcohol use have reported alcohol-related risk behaviors or consequences (e.g., problem drinkers, Donovan & Chung, 2015). In previous studies of U.S. samples, abstinent or low-intake classes represented the highest percentage of the sample. These studies demonstrate the utility of person-centered approaches such as LCA in providing more nuanced information about alcohol use patterns than single measures of alcohol use (e.g., initiation age, frequency of consumption). However, most previous research has focused on high school or emerging adult samples. Given the developmental differences among early adolescents and the propensity to initiate alcohol use during early adolescence, middle-school-aged youth might exhibit patterns of use that differ from those currently described in the extant literature. Research exploring alcohol use subgroups among early adolescents is needed to inform alcohol use prevention and intervention efforts.

**Stress-Coping Model of Adolescent Alcohol Use**
Stress and coping theories provide a general framework that can be used to explain adolescents’ alcohol use. Developed by Lazarus and Folkman (1984), stress-coping theory seeks to explain the process through which individuals adapt to stress. According to this model, stress occurs when an individual perceives that their environmental demands exceed their resources and are dangerous to their well-being. Individuals employ coping strategies in an effort to manage the source of distress or to regulate emotional responses. These coping functions are referred to as problem-focused coping and emotion-focused coping, respectively. Problem-focused coping involves steps such as seeking information, identifying solutions, weighing alternatives, and acting on a selected strategy than can be directed towards the environment or the individual. Emotion-focused strategies, sometimes referred to as avoidant coping in the literature, typically involve avoiding confrontation of the distressing event to make life or emotions more bearable. Cognitive strategies, such as reframing the event, or behavioral strategies, such as exercise or alcohol use, can be used in order to reduce psychological distress. Such strategies are used more often when the individual believes they lack control over the situation or cannot modify the harmful or threatening conditions in their environment. This theoretical model informs the stress-coping theory of adolescent substance use, which maintains that adolescents drink alcohol to reduce negative affect or increase positive affect when experiencing distress (Wills & Filer, 1996).

The stress-coping theory of adolescent alcohol use has been supported by empirical findings. First, there is a vast literature establishing stressful life experiences as risk factors for adolescent alcohol use, including negative life events (e.g., Biafora Jr. et al., 1994; Wills et al., 1992), peer victimization and exclusion (e.g., Meisel et al., 2018), child maltreatment (e.g., Hamburger et al., 2008; Kingston & Raghavan, 2009; Proctor et al., 2017), adverse childhood
experiences (e.g., Chatterjee et al., 2018; Duke, 2018), and exposure to community violence (e.g., Kilpatrick et al., 2000; Mrug & Windle, 2009). Additionally, evidence shows that adolescents perceive alcohol use as serving a coping function. A nationally representative sample of 12th-grade students in the U.S. self-reported their reasons for using alcohol (Johnston & O’Malley, 1986). Recent alcohol users identified several themes that represented coping motivations: “to relax or relieve tension” (40%), “to get away from my problems or troubles” (21%), “because of anger or frustration” (18%), and “to get through the day” (2%). Another study examined coping motives for alcohol use as a predictor of heavy drinking (Wills & Cleary, 1995). Among 10th-grade students, coping motives had a positive association with heavy drinking after controlling for other reasons for alcohol use (e.g., social influence, confidence, boredom, curiosity).

A preference for emotion-focused coping among adolescents may be explained developmentally. Early adolescents, who are only beginning to develop autonomy, may not yet have knowledge of problem-focused skills or the mental acuity to enact them. According to stress-coping theory, individuals who feel they have a lack of control over harmful or threatening environments are especially likely to employ emotion-focused strategies such as alcohol use (Lazarus & Folkman, 1984). Adolescents often do not have the ability to change their environment such as their family, school, or community and thus may perceive their experiences as outside of their control. This inability to problem-solve and the accessibility of alcohol (Johnston et al., 2021), may make adolescents susceptible to using alcohol to cope. Environmental stressors that increase the risk for alcohol use should be identified to effectively target interventions for adolescents with heightened risk for early alcohol use.

**Community Violence Exposure and Adolescents’ Alcohol Use**
Community violence exposure (CVE), which includes witnessing violent acts or threats committed by others in the community and being directly victimized or threatened with physical violence, is a particularly common environmental stressor among adolescents in the U.S.. In the most recent national sample of children and adolescents, over half (54.5%) reported lifetime victimization by physical assault and 27.5% had witnessed community violence in their lifetime (Finkelhor et al., 2013). Past year reports were particularly high among middle-school-aged youth (ages 10-13): 46.5% had been physically assaulted, 12.4% had been threatened with assault, and 21.1% had witnessed community violence in the past year. Youth who experienced one type of exposure were also at a greater risk of experiencing another type. Specifically, adolescents who witnessed violence in their lifetime had an 80% increased chance of also being victimized by assault or bullying and a 350% greater chance of experiencing another form of indirect violence exposure. Violence exposure is related to heightened severity of mental health outcomes among adolescents, including internalizing, externalizing, and post-traumatic stress disorder symptoms (Fowler et al., 2009), making CVE a key public health concern in the U.S.. Adolescents exposed to environmental stressors such as CVE may be more likely to increase their alcohol use as an emotion-focused coping mechanism due to a perceived lack of control over the community in which they live. This perception decreases self-efficacy to problem-solve and increases the drive to decrease negative emotions or increase positive emotions (Lazarus & Folkman, 1984), suggesting that CVE may increase the likelihood that early adolescents initiate alcohol use or consume heavier amounts of alcohol as an emotion-focused coping strategy.

A body of empirical literature has examined the relation between CVE and alcohol use. These studies vary widely in their measurement of violence exposure and alcohol use behaviors. Researchers have operationalized violence exposure as one type of adverse event included in a
comprehensive measure, combined witnessing violence and personal victimization, and used separate subscales for witnessing violence and physical victimization. Further, the individual’s frequency of alcohol consumption and age at alcohol initiation have both been examined as alcohol use outcomes of CVE. This literature is reviewed in the following sections.

**Alcohol Use Frequency**

Several cross-sectional studies have found a positive association between CVE and frequency of alcohol use. Among a sample of adolescents in grades 6, 8, and 10 in an urban school system, past year frequency of witnessing violence was related to past 30-day frequency of alcohol use after controlling for demographic variables (i.e., gender, grade, free lunch status, ethnicity; Schwab-stone et al., 1995). Another widely-cited study of a community sample of adolescents in the U.S. investigated physical assault and witnessing violence as unique predictors of alcohol abuse and dependence (Kilpatrick et al., 2000). Results of hierarchical logistic regression analyses showed that a history of physical assault and having witnessed violence uniquely increased the likelihood of problematic alcohol use after controlling for other stressful live events including familial substance use, sexual assault, and PTSD symptoms. Witnessing violence was the strongest predictor in this model, such that every additional experience of witnessing violence increased the odds of alcohol abuse by 173% compared with a 71% increase for one additional experience of past physical assault. Lee (2012) examined data from youth in grades 7, 9, 11, and 12 attending public schools in a “high risk” urban school district with high rates of poverty, unemployment, and serious crimes. Logistic regression analyses indicated that witnessing violence (i.e., seen somebody being beaten up, seen somebody stabbed or shot) increased the odds of alcohol or drug use and binge drinking during the past year. Among adolescents aged 9, 12, 15, and 18 living in Chicago, Zimmerman and Kushner (2017) found that
lifetime levels of witnessing violence increased the odds of past year alcohol use. These effects were significant after controlling for individual, family, and neighborhood risk factors. In conclusion, there is clear cross-sectional evidence for relations between adolescents’ alcohol use and witnessing community violence, and some evidence of associations with physical victimization (Kilpatrick et al., 2000).

Several longitudinal studies have found relations between witnessing violence and victimization and changes in alcohol use. Wright et al. (2013) examined exposure to witnessing and victimization by violence across various settings (i.e., community, school, home abuse, parental intimate partner violence) as predictors of past year frequency of alcohol use in a sample of Chicago youth aged 9, 12, and 15. When violence exposure in all four settings was entered simultaneously into a regression model, they combined to predict more frequent alcohol consumption, but no one setting of violence exposure was a significant predictor. In other words, witnessing and being victimized by violence in the community did not explain variance in alcohol consumption above and beyond school, home, and interparental violence. Another study examined longitudinal relations between past-year CVE and alcohol use at two waves, one and seven years later, among a nationally representative sample of students in grades 7 through 12 (Thompson et al., 2008). Results of structural equation models indicated that CVE predicted more problematic alcohol use one year later, however, there was a significant inverse relation with alcohol use at the 7-year follow-up for female participants. Latent growth analyses indicated that higher initial levels of victimization related to slower rates of acceleration in alcohol use over time. These results must be interpreted cautiously because violence exposure was measured by a composite of a single witnessing item (e.g., seeing someone shot or stabbed) and four personal victimization items (e.g., pulled a knife on you, shot you, cut or stabbed you, injured in
a physical fight). Four of these items represent severe forms of victimization with a weapon that are relatively uncommon in the general population (Finkelhor et al., 2013). Further, the low incidence rate in the sample, with only a 4 to 12% occurrence of one or more item at any wave of data collection resulted in a restricted range, which may have attenuated the effect. Although prior studies using broad measures that include both witnessing and victimization have generally supported a positive relation between CVE and adolescents’ frequency of alcohol use, they do not provide a basis for determining the unique effects of witnessing community violence and physical victimization on adolescents’ alcohol use.

Prior research suggests that witnessing violence towards others may have a stronger impact on alcohol use than being directly victimized in the community. For example, one study found different results for witnessing violence and victimization when examining their relations with alcohol use from ages 14 to 23 (Goldstick et al., 2019). These data were from the Flint Adolescent Study, a primarily African American (80%) cohort study of students identified as high risk for high school dropout. Generalized additive models, an extension of generalized linear models that use a semi-parametric regression function rather than a linear function, found that both witnessing violence and physical victimization were positively related to trends in alcohol use over time. Within-person changes in witnessing violence were positively related to alcohol use and became stronger across the entire age range, but within-person changes in victimization were not significantly related to alcohol use. This indicates that an individual’s spike in witnessing violence at one time point relative to their overall trajectory was related to increases in alcohol use, but this was not the case for victimization.

A longitudinal study of a racially and ethnically diverse sample of youth aged 9, 12, and 15 years old that was collected as part of the Project on Human Development in Chicago
Neighborhoods project sought to determine the unique effects of CVE types on frequency of alcohol use and binge drinking (Pinchevsky, Wright, et al., 2013). Witnessing violence and victimization each predicted a greater frequency of past year alcohol use and past month binge drinking for male and female adolescents. When accounting for both types of CVE and other risk factor variables (e.g., age, race, self-control, drug availability, peer substance use, parental drinking, curfew, prior drug use), physical victimization was nonsignificant and witnessing violence remained a significant predictor, but only for female adolescents. Therefore, having witnessed violence accounted for a significant portion of the variance in female adolescents’ alcohol use, but not in male adolescents’ alcohol use, after controlling for physical victimization and other risk factors for alcohol use. These findings demonstrate the importance of isolating the effects of witnessing and victimization experiences. The body of literature reviewed thus far suggests that adolescents exposed to higher rates of CVE tend to consume alcohol more frequently concurrently and over time, and that this association may be stronger for experiences of witnessing violence than physical victimization.

**Alcohol Use Initiation**

Stress-coping theory suggests that higher levels of exposure to environmental stressors such as CVE (Finkelhor et al., 2013) paired with underdeveloped problem-solving skills and coping resources among early adolescents increases the susceptibility of middle-school-aged youth to initiate alcohol use to cope with distress. A literature search revealed several studies that assessed the contemporaneous association between CVE and alcohol initiation during early adolescence. Whitesell and colleagues (2009) investigated adversity exposure as a predictor of age of alcohol initiation among 2,927 individuals between the ages of 15 and 45 from American Indian reservation communities. The participants reported their age at the time of adverse events
they experienced in their home and community (e.g., major childhood events, traumas, witnessing violence, heard traumatic news, significant deaths) before age 18 and their age when they first consumed alcohol. Experiencing a higher number of adverse life events before alcohol use initiation related to an earlier onset of alcohol use. In a regression model accounting for each type of adversity, witnessing violence uniquely predicted alcohol initiation before age 13.

However, this study has several limitations. The measure used to assess witnessing violence included violence in the home and the community. Due to the sole inclusion of individuals of American Indian heritage, the results cannot be generalized to individuals of other ethnic and cultural backgrounds. Another study used a national household probability sample of youth ages 12 through 17 to examine a composite measure of CVE (i.e., witnessing and victimization) in relation to initiation of nonexperimental alcohol use, defined as drinking five or more standard drinks on a given day in the past year (Kilpatrick et al., 2000). An analysis of covariance indicated that adolescent substance abusers who were exposed to violence reported a younger age at initiation of alcohol use than those who had not been exposed to violence. However, this relation only trended toward significance (i.e., $p = .059$). Because the sample only included youth who currently met criteria for DSM-IV alcohol abuse or dependence, the findings may not generalize to adolescents with non-clinical levels of alcohol use. Bossarte and Swahn (2008) investigated the association between witnessing community violence and initiation of alcohol use using the 2004 Center for Disease Control’s Youth Violence Survey, a cross-sectional survey of adolescents attending public schools in a “high risk” urban school district. Their specific focus was on identifying the relative risk of various psychosocial factors for early alcohol onset among seventh grade students. Witnessing violence in the community was associated with an increased
likelihood of alcohol use before age 13 after controlling for other individual (e.g., sex, race), peer (e.g., support, delinquency), and family risk factors (e.g., household violence).

In general, prior research supports a link between CVE and initiating alcohol use during early adolescence. However, these studies have several limitations. The simultaneous assessment of the independent and dependent variables does not provide clear support for a causal association. Further, retrospective reports provided by adults (e.g., Whitesell et al., 2009) and older adolescents (e.g., Kilpatrick et al., 2000; Lee, 2012) of alcohol use and events that occurred during early adolescence are subject to recall bias. These limitations have been addressed by longitudinal and prospective studies of adolescents.

Two longitudinal studies assessed CVE in addition to other adverse life experiences. In the Pittsburgh Girls study, female adolescents living in predominantly low-income urban neighborhoods completed annual interviews for 15 years. Sartor and colleagues (2018) used interviews taking place at ages 11- through 17-years to examine traumatic experiences in relation to alcohol initiation. Trauma included witnessing community violence, involvement in a serious accident, and interpersonal trauma. Age at alcohol initiation was defined as the age when participants first reported consuming alcohol five or more times or one to two drinks per drinking occasion in the past year. Cox proportional hazards regression analyses indicated that trauma uniquely predicted an increased likelihood that participants used alcohol between ages 11 and 17 after controlling for race, SES, and neighborhood factors. Because this study only included female adolescents, the results cannot be generalized to male adolescents. Another caveat of this study is the comprehensive measure of traumatic experiences. Combining numerous events into one variable prevents researchers from determining the relative impact of witnessing community violence compared with other traumas.
In contrast, Ramos-Olazagasti and colleagues (2017) examined the unique impact of different adverse childhood experiences on early alcohol initiation. Participants were Puerto Rican adolescents ages 10 to 13 living in New York and Puerto Rico who completed three yearly follow-up interviews. Researchers assessed 12 childhood adversities within the broad domains of parental loss, maltreatment, parental maladjustment, and sociocultural stressors (i.e., discrimination, violence exposure). Violence exposure included witnessing, direct victimization, or knowing someone exposed to violent acts. A survival analysis found significant positive effects for several predictors, including violence exposure. The main effects were significantly moderated by gender, such that female adolescents exposed to violence were more likely to initiate alcohol use before age 14 than male adolescents exposed to violence. Models that included all adversities and interaction terms indicated that violence exposure among female adolescents remained significant after controlling for other stressors, more than doubling the risk for alcohol use before age 14. These results suggest that CVE is a robust predictor of early alcohol initiation, even beyond that of other violent and nonviolent life stressors. However, due to the focus on Puerto Rican youth, results cannot be generalized to other adolescents living in the U.S.. Further, a single variable representing all types of CVE prevents researchers from distinguishing between witnessing violence and direct physical victimization.

The specific impact of witnessing community violence and physical victimization have also been examined in relation to alcohol use initiation. Taylor and Kliewer (2006) interviewed 101 African American early adolescents (ages 9 to 13) living in neighborhoods with moderate-to-high rates of violence at two waves 6 months apart. Separate logistic regression analyses indicated that witnessing violence, victimization, and hearing about violence reported at the initial interview was related to participants having used alcohol in their lifetime. However,
because alcohol use was only assessed at the second interview, they could not determine sequential ordering, or whether alcohol use occurred before or after the initial interview. Moreover, because the small sample size did not provide sufficient power to enable researchers to include all types of violence exposure in the same analysis, they could not determine the unique effect of each form of exposure. Among a sample of early adolescents (Mean age = 11.8), Mrug and Windle (2009) controlled for prior alcohol use and included witnessing violence and victimization as simultaneous predictors in a model predicting alcohol use initiation. Adolescents’ past year frequency of witnessing violence, but not victimization, was associated with alcohol use before Wave 1. Among those who had not initiated alcohol use at Wave 1, higher levels of witnessing violence and lower levels of victimization predicted initiating alcohol within the next 16 months. Results suggest that witnessing violence may lead to alcohol initiation, whereas being victimized might decrease the likelihood of alcohol use. Generalization of these results is limited by the primarily African American (78%) and White (21%) sample. The findings are consistent with literature in the prior section of this review on the impact of witnessing violence exposure, where witnessing violence was the only unique predictor of increases in alcohol consumption over time (Goldstick et al., 2019; Pinchevsky, Wright, et al., 2013).

Sex and Gender Differences

There is evidence of sex and gender differences in the prevalence of CVE and alcohol use in the U.S.. Population prevalence rates indicate that male adolescents are more likely to experience physical assault compared with female adolescents (Finkelhor et al., 2013). Male youth are also significantly more likely to witness an assault in the community, but witness other forms of violence (i.e., shootings, family assault, physical abuse, household theft) at similar rates
as female youth. Findings on gender differences in the prevalence of early alcohol use initiation are mixed. Whereas one representative school-based sample showed a significantly higher prevalence of alcohol use among male adolescents before age 13 (Kann et al., 2018), results of a household survey suggest that female adolescents are more likely to initiate alcohol use at an early age (Forman-Hoffman et al., 2017). This inconsistency could be explained by more male students being absent during school-based survey administration than in community-based surveys. There is also some evidence that male adolescents may transition to frequent alcohol use more quickly after initiation than female adolescents (Chen & Jacobson, 2012; Wittchen et al., 2008). Prior research using LCA to study patterns of alcohol use have found that male adolescents had a greater probability of engaging in more frequent and heavier patterns of alcohol use (Gohari et al., 2020; Reboussin et al., 2006). Male adolescents may therefore be expected to experience more CVE and consume alcohol more heavily than female adolescents.

Although male adolescents report higher rates of CVE and alcohol use, research suggests that CVE has a stronger impact on female adolescents’ alcohol use. Ramos-Olazagasti et al. (2017) found that among adolescents exposed to violence, female adolescents were more likely than male adolescents to initiate alcohol use before age 14. In another study, witnessing violence related to higher frequency of alcohol use and binge drinking while controlling for other risk factors among female adolescents, but not male adolescents, (Pinchevsky, Wright, et al., 2013). These results suggest that female adolescents may be more likely to consume alcohol frequently as a result of their exposure to community violence, but future investigation into the impact of sex on this association is needed.

**Youth in Rural Communities**
It is notable that most of the literature discussed thus far has focused on adolescents deemed “high risk” for CVE. Research often targets neighborhoods experiencing high rates of violence or focuses on adolescents living in urban areas. Although rates of violence are generally higher in urban locations, youth living in rural communities also experience violence (Slovak & Singer, 2002). One study examined violence exposure among youth ages 2 through 17 years, with approximately half living in urban cities (i.e., Boston, Philadelphia) and half in rural areas in the state of Tennessee (Turner et al., 2019). They found a higher prevalence of witnessing gun violence, hearing gunshots in public, and direct victimization among urban youth, but an equal occurrence of direct gun violence exposure, crime victimization, and peer victimization among urban and rural youth. Further, a meta-analysis found that the effects of violence exposure on mental health outcomes did not differ between samples targeted as “at-risk” compared with those not targeted (Fowler et al., 2009). This highlights the need to examine the impact of CVE on alcohol use among youth living in rural areas in addition to urban areas.

A literature search identified only two prior studies that examined the association between violence exposure and alcohol use among rural samples of adolescents. The relation between witnessing violence and changes in drug use was examined in a predominantly African American sample of students attending urban middle schools and a more racially diverse sample of students attending rural middle schools (Farrell & Sullivan, 2004). In both settings students who reported a high frequency of witnessing violence at the beginning of sixth grade also reported higher initial levels of drug use (i.e., alcohol, cigarettes, marijuana) and greater increases in their frequency of drug use throughout middle school. This study combined alcohol and other drugs into one variable, so it is not clear whether the findings reflected increases in the use of alcohol or other drugs. They do, however support a positive relation between witnessing
violence and substance use among adolescents living in rural settings. A second study included a sample of sixth grade students living in rural communities in the southern U.S. (Sullivan et al., 2004). A hierarchical logistic regression analysis indicated that adolescents who reported more frequent lifetime exposure to witnessing violence at the beginning of sixth grade had a greater probability of initiating beer, wine, liquor, and advanced alcohol use (i.e., getting drunk) by the end of sixth grade. Future research should continue to explore both victimization and witnessing CVE in relation to alcohol use among samples of youth from diverse communities.

**Nonviolent Stressors**

There is evidence that exposure to nonviolent stressors also relates to adolescents’ alcohol use. One study examined the unique effects of witnessing violence, physical victimization, and nonviolent negative life events on substance use (e.g., alcohol, tobacco, illicit drugs) among a predominantly African American (80%) sample of adolescents attending urban middle schools (Thompson et al., 2019). Researchers found that nonviolent negative life events (i.e., family stressors, transitions, resource limitations, neighborhood stressors) uniquely accounted for variance in substance use after controlling for both witnessing violence and physical victimization. Frequency of witnessing violence had the strongest relation with substance use, and experiencing nonviolent stressors was more strongly related to substance use than physical victimization. Another study examined the extent to which stressful life events predicted transitions in classes of alcohol use from adolescence (i.e., grades 7 through 12) into young adulthood (i.e., 13 years later; Hoyland & Latendresse, 2018). Four latent classes of alcohol use were identified at three waves, including *abstainers, low-intake drinkers, nonproblem drinkers, and problem drinkers*. Results of latent transition analysis indicated that adolescents exposed to stressful life events were more likely to transition to classes representing
heavier alcohol use than would be expected based on developmental trends of alcohol use. These results indicate that exposure to nonviolent stressors also relates to adolescents’ alcohol use, and that the relative influence of nonviolent stressors should be controlled for when examining the unique association between exposure to community violence and alcohol use.

**Statement of the Problem**

Early adolescent alcohol use remains an important area of study given the extent of short- and long-term consequences associated with early alcohol use. However, prior research is limited in the methods used to study adolescent alcohol use. Studies investigating early initiation of alcohol use often use a single binary variable to represent alcohol use before age 13 or 14 (e.g., Ramos-Olazagasti et al., 2017; Sartor et al., 2018). Although such measures indicate whether initiation occurred, it is unlikely that early alcohol experimentation will be associated with serious consequences if the use does not continue or progress to heavier amounts of consumption. Other studies have examined adolescents’ frequency of alcohol use within the past 30 days or 12 months (e.g., Schwab-stone et al., 1995, Wright et al., 2013). This limits insight into the variability in alcohol use behaviors. For example, an adolescent who reportedly consumed no alcohol in the past month might represent an individual who has never tried alcohol, or someone who tried alcohol and subsequently desisted use. Recent research indicated that the experience of drunkenness is important to consider when studying adolescent alcohol use, such that age of first drunkenness was more predictive of problem behaviors than age of alcohol initiation (Kuntsche et al., 2013). Additionally, frequent alcohol consumption increases the likelihood of adolescent risk behaviors (K. D. Thompson et al., 2012). Youths likely vary widely in their alcohol use patterns, such that some are at a higher risk for negative outcomes than others due to their unique combination of alcohol use behaviors (e.g., initiation, frequency
of use, getting drunk). The use of only one observed variable to represent alcohol use thus limits the utility of research in furthering our knowledge and ability to prevent early adolescents’ alcohol use.

Prior research has primarily used variable-centered approaches that assume the population is homogenous, such that the association between two variables is expected to be the same for all individuals in a population (Masyn, 2013). Variable-centered methods are consequently unable to capture similarities or differences among individuals in a heterogenous population. An alternative approach is LCA, which assumes that heterogeneity in a population can be explained by an underlying latent variable (Lanza et al., 2013; Masyn, 2013). LCA allows researchers to take a holistic perspective of the behavior of individuals while minimizing measurement error (Lanza & Cooper, 2016). This approach is ideal for studying the heterogeneity of alcohol use within a population. In past research this approach has provided valuable information about high-risk patterns of substance use that can be used to inform prevention or intervention efforts (Lanza & Cooper, 2016). Moreover, Lanza and Rhoades (2013) demonstrated that the LCA approach can be used to inform how programs are tailored to specific population subgroups. For example, LCA could be used to determine what intervention will work best for an adolescent based on their current pattern of alcohol use. There is currently limited research describing heterogeneity in alcohol consumption among middle-school-aged adolescents. To inform primary prevention efforts targeting high-risk adolescents, researchers first need to identify the patterns of alcohol use that emerge during early adolescence. An LCA using alcohol initiation and frequency of consumption as indicators of early adolescents’ alcohol use patterns could fill this gap in the literature. Moreover, despite evidence that alcohol use and binge drinking is highly prevalent among adolescents in rural areas (Gale et al., 2012; Patrick et
al., 2013), few prior studies have focused on alcohol use in rural populations. Additional research is therefore needed that describes heterogeneity in patterns of alcohol use that emerge among rural middle school students.

Previous research examining patterns of adolescents’ alcohol use have not typically included indicators representing use of different types of alcoholic beverages that vary in their average alcohol content (e.g., beer, wine, liquor). However, there are data to suggest that the type of alcohol consumed relates to other characteristics of early adolescents’ alcohol use. Students attending public schools in Chicago who consumed liquor at age 13 were more likely to have been drunk, engaged in heavy drinking, and recently consumed alcohol at age 14 compared with those who had consumed only wine (Maldonado-Molina et al., 2010). Among adolescents in Canada, drinking both beer and liquor, and drinking beer, liquor, and wine, predicted heavy drinking (Smart & Walsh, 1995). These results indicate that the type of alcoholic beverage consumed by adolescents might reflect varying patterns of alcohol use and should be considered when investigating heterogeneity in alcohol use.

It is important to identify risk factors that increase the likelihood that adolescents will engage in potentially harmful patterns of alcohol use. According to the stress-coping theory of adolescents’ alcohol use, those who experience demanding environmental stressors are more likely than their peers to consume alcohol to alleviate distress. CVE is a prevalent stressor among adolescents in the U.S. and a vast body of literature has supported an association between CVE and alcohol use among adolescents, but there are several notable limitations within this literature. The operationalization of CVE has varied, with some studies focusing on the impact of witnessing community violence (e.g., Mrug & Windle, 2009; Sullivan et al., 2004) and others combining the effects of witnessing community violence and physical violence victimization into
a single measure of CVE (e.g., Sartor et al., 2018). Many studies have used composite measures that include both violent and nonviolent stressors (e.g., ACEs), which prevents researchers from determining whether one type of exposure is more strongly related to alcohol use outcomes. Few studies have explored unique associations between types of violence exposure (i.e., witnessing, victimization) and adolescent alcohol use, or controlled for exposure to other nonviolent stressful life events. Given the high rates exposure to violence among adolescents in the U.S. (Finkelhor et al., 2013), more research is needed to elucidate possible relations between exposure to witnessing violence, victimization, and nonviolent stressors and adolescents’ alcohol use.

The Current Study

The current study had three aims designed to address limitations in the literature. The first aim was to describe heterogeneity in self-reported alcohol use among middle school students using a finite number of discrete alcohol use classes. The specific focus was on an ethnically diverse, school-based sample of adolescents attending middle schools in a rural southeastern area of the U.S.. Participants completed measures of their lifetime and past 30-day frequency of consumption of three types of alcoholic beverages (i.e., beer, wine, liquor), and lifetime and past 30-day frequency of drunkenness, which served as indicators of their subgroup membership. Consistent with prior empirical findings among adolescents, I hypothesized that alcohol use subgroups would differ significantly on alcohol initiation, initiation of drunkenness, and frequency of recent alcohol use and drunkenness. This study also explored whether the type of alcoholic beverage consumed differed across subgroups. I hypothesized that the largest portion of the sample would be a subgroup representing abstinence, and the smallest subgroup would be characterized by patterns representing the highest severity of alcohol use.
The second aim of this study was to determine whether membership in alcohol use classes varied as a function of participants’ sex, grade, and racial-ethnic background. Previous studies have found that male adolescents were more likely than female adolescents to be in latent subgroups using alcohol compared with abstinence, and subgroups engaging in more frequent binge drinking and drunkenness compared with light-drinking classes (Donovan & Chung, 2015; Gohari et al., 2020; Jackson et al., 2014; Reboussin et al., 2006). Another potential covariate of class membership is grade. Prior research has found that age is associated with alcohol use class membership, with older age associated with increased odds of being a light or heavy drinker (Donovan & Chung, 2015; Gohari et al., 2020) or being a problem drinker (Reboussin et al., 2006). However, prior studies compared broad age ranges, such as early versus middle adolescents (e.g., Dauber et al., 2009; Reboussin et al., 2006) and did not compare differences across middle school grades. Evidence also suggests that rates of alcohol use vary across adolescents from different racial and ethnic backgrounds, with White youth being most likely to consume alcohol, lower rates among Hispanic or Latinx youth, and lowest rates among African American youth (Johnston et al., 2018). Prior studies have identified different patterns of alcohol use between African American, White, and Latinx adolescents (Dauber et al., 2009; Khan et al., 2014), and differences in their likelihood of class membership (Donovan & Molina, 2013). This suggests that class membership may vary based on adolescents’ racial-ethnic identity. I thus hypothesized that sex, grade, and racial-ethnic background would significantly relate to class membership, such that the proportions of individuals in each class would differ based on these demographic characteristics. Specific hypotheses regarding group differences were formed following the completion of Aim 1 and are discussed in the results section.
The third aim of the study was to determine whether exposure to community violence and nonviolent stressors were associated with latent class membership. The first part of this aim was to examine the relations between witnessing community violence, physical victimization, and three types of nonviolent stressors and alcohol use subgroups (Aim 3a). I also examined whether each exposure variable related to class membership while controlling for all other exposure variables and peer pressure for substance use (Aim 3b). Consistent with theory and previous research, I hypothesized that exposure to community violence and nonviolent stressors would uniquely increase the likelihood that adolescents would be in alcohol use classes versus abstinence. More specific hypotheses regarding alcohol use class differences were formed after the completion of Aims 1 and 2 and are discussed in the results section. Prior research also suggests that the association of exposure to stressors and alcohol use might vary across sex or gender (Pinchevsky, Wright, et al., 2013; Ramos-Olazagasti et al., 2017). The second part of this aim was to examine the extent to which sex moderated the associations between CVE (i.e., witnessing, physical victimization) and class membership (Aim 3c).

**Methods**

**Participants and Study Setting**

This study involved analysis of cross-sectional data collected as part of a project that evaluated a youth violence prevention program, Responding in Peaceful and Positive Ways, in five rural school districts in a city in the southeastern U.S. (N = 8846; Farrell et al., 2003). Data for this project were collected from three cohorts of middle school students at five intervention schools and four control schools over the course of 4 years (fall 1997 to fall 2000). Each cohort completed measures during the fall and spring terms. Their responses were screened based on
procedures for identifying surveys whose pattern of responses met criteria for random responding (Farrell et al., 1991).

The present study used a cross-sectional wave of data collected during the spring of 2000 when Cohort 1 was in eighth grade \((n = 1444)\), Cohort 2 was in seventh grade \((n = 1740)\), and Cohort 3 was in sixth grade \((n = 1827)\). A portion of students in the study participated in the RIPP sixth grade intervention \((36\%)\), seventh grade intervention \((23\%)\), and eighth grade intervention \((7.2\%)\). Data obtained for Cohorts 2 and 3 indicated that over half of students were eligible for the federal free or reduced school lunch program \((i.e., 56\%)\). About 50\% of the sample were female adolescents. Nearly half the sample \((46.4\%)\) self-identified as White or Caucasian American, 25.5\% as Hispanic or Latinx, 13.4\% as African American or Black, 6.7\% as “other” ethnicity, 3.5\% as American Indian or Native American, and 1.1\% as Asian American.

**Procedures**

The project was approved to use passive consent by the University’s Institutional Review Board. Parents were notified of the study and given the opportunity to remove consent for their child to participate. Teachers administered survey measures to all other students in all non-special education classes at each school. Teachers read confidentiality instructions and instructed students who did not wish to participate to hand in blank booklets. All booklets were immediately placed in envelopes and sealed after they were turned in.

**Measures**

**Alcohol Use.** The Problem Behavior History Scale (PBHS) was adapted from Farrell et al. (1992) to assess participants’ lifetime alcohol consumption. Items asked participants to report if they had ever engaged in 14 problem behaviors, even if only one time, on a dichotomous “yes”
or “no” scale. The scale included four items assessing history of alcohol consumption: “been drunk,” “drunk beer (more than a sip or taste),” “drunk wine or wine coolers (more than a sip or taste),” and “drunk liquor, like whisky or gin (more than a sip or taste).” Participants also reported their frequency of alcohol use in the past 30-days on the Problem Behavior Frequency Scale (PBFS; Farrell et al., 1992). Items asked participants to report about how many times they had engaged in 36 problem behaviors in the past 30 days on a Likert scale from 1 (Never) to 6 (20 or more times). The scale assessed the frequency of four types of alcohol use: “been drunk,” “drunk beer (more than a sip or taste),” “drunk wine or wine coolers (more than a sip or taste),” “drunk liquor, like whisky or gin (more than a sip or taste).”

Items from the PBHS and PBFS assessing the same type of alcohol use (i.e., beer, wine, liquor, drunk) were recoded into four categorical variables with seven response categories representing lifetime and past 30-day frequency of alcohol use: “never in lifetime,” “initiated use & used 0 times in the past 30 days,” “used 1 to 2 times in the past 30 days,” “used 3 to 5 times in the past 30 days,” “used 6 to 9 times in the past 30 days,” “used 10 to 19 times in the past 30 days,” “used 20 or more times in the past 30 days.” Less than 2% of respondents (ns = 66 -102) provided inconsistent responses for their lifetime alcohol use and past 30-day frequency of use (i.e., endorsed “no” for lifetime use and endorsed >0 times for past 30-day use). Most of the inconsistent responses across items (i.e., 75 – 88%) were reporting no lifetime use and “1 to 2 times” for past month use. For cases where reporting was inconsistent, items were coded based on past month frequency of use. The resulting four items were used as ordered categorical indicators of latent class membership.

**Exposure to Violence.** Participants self-reported their lifetime frequency of exposure to violence on the Exposure to Violence Scale adapted from Cooley and colleagues’ (1995)
Children’s Report of Exposure to Violence. The measure included three subscales: Exposure to Violence-Victimization (7 items), Exposure to Violence-Stranger (6 items), Exposure to Violence-Familiar Person (6 items). This project excluded items in the original scale assessing violence in the media. Items asked participants to report about how many times they had witnessed or experienced specific acts of violence in their lifetime (e.g., “seen a stranger robbed or mugged,” “been robbed or mugged”) on a 4-point Likert scale with 1 (No, Never), 2 (One Time), 3 (A Few Times), and 4 (Many Times). Subscale scores reflect the sum across all subscale items. A prior study found good test-retest reliability, internal consistency, and construct validity of the scale (Cooley et al., 1995). A confirmatory factor analysis indicated that a three-factor model was the best fit to the data. The two subscales that measured experiences of witnessing violence towards others (i.e., stranger, familiar person) were highly correlated ($r = .87$), indicating that a degree of multicollinearity would be present in the regression analyses. In the present study, the Exposure to Violence-Stranger subscale (Cronbach’s $\alpha = .83$) was used to reflect witnessing community violence and the Exposure to Violence-Victimization subscale (Cronbach’s $\alpha = .59$) was used to reflect physical victimization by violence. Although high internal consistency would not necessarily be expected for a measure that assesses the frequency of experiencing different types of violent victimization (e.g., “been beat up”, “been shot with a gun or stabbed with a knife”), these values suggest that individuals who experienced one form of violence were likely to experience others.

**Exposure to Nonviolent Stressors.** The Interpersonal Problem Situations Inventory for Urban Adolescents (Farrell et al., 1998) assessed the frequency of participants’ experiences with nonviolent environmental stressors. A series of studies by Farrell et al., (1998) established the content and construct validity of this measure. Items were derived from a qualitative study in
which urban adolescents identified situations that presented the biggest problems for them. Items asked participants to rate the frequency of occurrence of 14 items in the past year on a 5-point scale with 1 (never), 2 (once or twice a year), 3 (once or twice a month), 4 (once or twice a week), and 5 (almost every day). Content analyses identified three separate scales representing peer provocation (e.g., “someone joked about your mother or your father”), unfair situations (e.g., “a teacher punished you unfairly”), and environmental stress (e.g., “you were scared to go to school because someone you know had a gun”). Again, although the internal consistency for these scales was low (Cronbach’s $\alpha$ for peer provocation = .51, environmental stress = .56, unfair situations = .78), this is somewhat expected for a measure reflecting a diverse array of different negative experiences.

**Peer Pressure for Substance Use.** Participants reported their frequency of being pressured by peers to use substances in the last 30-days on the PBFS (Farrell et al., 1992). Four items asked participants to report about how many times they had been offered (e.g., “been offered alcohol/drugs by one of your friends”) or felt pressured to use alcohol or drugs (e.g., “Felt pressured by your friends to drink/use drugs”) in the last 30 days on a Likert scale from 1 (Never) to 6 (20 or more times). Subscale scores reflect the sum across all subscale items (Cronbach’s $\alpha = .77$).

**Demographics.** Sex was determined by asking respondents to indicate if they were a “boy” or a “girl.” Other options to report sex or gender identity were not included in the survey. Participants’ grade was based on homeroom classroom. Each student’s intervention status was determined based on whether they had been in a homeroom classroom where the Responding in Peaceful and Positive Ways program had been implemented and was included as a control variable in analyses.
Participants’ racial-ethnic background was assessed by asking them to select the race or ethnicity that best described them. Response options included “Asian American,” “African American or Black,” “Hispanic or Latino,” “White, Caucasian American, or European,” “American Indian or Native American,” or “Other.” For purposes of examining racial-ethnic background in analyses, dummy-coded variables were created for African American or Black and Hispanic or Latinx adolescents. A third dummy variable combined adolescents of American Indian or Native American, Asian, and “other” racial-ethnic backgrounds due to small cell sizes. White adolescents were selected as the reference group because they typically report the highest rates and most frequent alcohol use (Johnston et al., 2018).

Data Analyses

All analyses were conducted in Mplus version 8.5. Aim 1 was addressed by estimating a series of latent class models. The four alcohol-use items representing use of wine, beer, liquor, and getting drunk were treated as ordered categorical variables. Ordered categorical variables are often recoded as binary variables, or the number of response categories are reduced by combining categories. I instead used a “progressive elaboration” approach (Donovan & Chung, 2015) to empirically determine cut points for ordinal indicators of latent class that resulted in the best-fitting models. Three progressive elaboration steps were adapted following procedures recommended by Donovan and Chung (2015). First, latent class enumeration was completed using trichotomous indicators of latent class to identify contender models with K classes. Following the class enumeration steps described by Masyn (2013), multiple models were run starting with one class and increasing the number of classes by one until the model did not successfully converge. Second, within several K-class contender models, progressive elaboration of the cut points was conducted for each of the four indicator variables in turn. In this step,
progressively higher cut points were tested for one indicator at a time after fixing cut points for previously tested indicators. The process progressed through indicators in order of increasing intensity of involvement with alcohol use, determined based on frequency of use in the current sample. Third, the best-fitting model was selected from the K-class models with empirically-derived indicator categories based on recommendations by Masyn (2013).

The optimal number of subgroups in steps one and three of the progressive elaboration approach was determined based on model fit indices, class size consideration, classification diagnostics, and theory (Masyn, 2013). Relative fit indices were used to evaluate competing models including the Bayesian information criterion (BIC; Schwartz, 1978), sample-size adjusted Bayesian information criterion (SABIC), Akaike’s information criterion (AIC; Akaike, 1974), consistent Akaike’s information criterion (CAIC; Bozdogan, 1987), approximate weight of evidence criterion (AWE; Banfield & Raftery, 1993), and relative improvement (RI). Smaller BIC, SABIC, AIC, CAIC, and AWE values indicate better fit. RI compared improvement in two models relative to the greatest possible improvement in model fit. A larger RI value indicates that adding an additional class improved model fit (Masyn, 2013).

Two comparative fit indices were examined: Bayes factor (BF), and the correct model probability (cmP). A larger BF indicates a greater probability of model K being the correct model relative to another model. The cmP closest to one indicates a greater probability that model K is correct. Relative model fit was evaluated based on the significance of two likelihood ratio tests: The Lo-Mendell-Rubin likelihood ratio test (adjusted LMR-LRT; Lo et al., 2001) and parametric bootstrapped likelihood ratio test (BLRT; McLachlan & Peel, 2000). A statistically significant adjusted LMR-LRT or BLRT (p < .05) indicates that the K-class model has better model fit than the model with one less class.
Candidate models were evaluated for classification quality, class homogeneity, and class separation using classification diagnostics. Masyn (2013) noted that a useful model has well-separated and highly differentiated classes with a high degree of homogeneity within each class. Entropy measures precision of classification within classes, with values closer to 1.0 suggesting more accurate classification. Class sizes were also considered as an indicator of the quality of each model following guidelines suggesting that the smallest class include at least 5% of the sample (Masyn, 2013). Posterior probabilities assess each individual’s probability of membership in each class based on their response patterns relative to the typical response profile for each class. An average posterior probability (AvePP) greater than .80 supports an appropriate degree of class separation. The odds of correct classification (OCC) indicates the probability of assignment to the modal class relative to the odds of correct classification based on posterior probabilities. An OCC greater than 5 suggests adequate separation and classification precision. After the final model was selected in the class enumeration process, the classes were interpreted based on the model-estimated class-specific item response probabilities and response patterns. The item endorsement probabilities within each subgroup were examined, such that values greater than .70 and less than .30 indicated high homogeneity of item endorsement (Masyn, 2013). The response patterns were inspected to determine which responses were most characteristic of each class and support subgroup interpretation.

Recent advancements in finite mixture modeling suggest that differential item functioning (DIF), a form of measurement noninvariance, occurs when there are direct associations between covariates and latent class indicators (Masyn, 2017). These relations can be uniform across subgroups. For example, male adolescents in all latent classes may have higher scores on an indicator than female adolescents (i.e., uniform DIF). They can also be nonuniform
across subgroups, such that sex differences in scores on a given indicator vary across classes (i.e., nonuniform DIF). Omission of these direct effects from the measurement model can result in model misspecifications and biased estimates for the covariates’ associations with latent class membership. Accordingly, tests of DIF should be completed prior to examining structural relations between covariates and class membership to avoid biased results. DIF by sex, grade, and racial-ethnic group was evaluated using the stepwise procedure recommended by Masyn (2017). This included tests of nonuniform and uniform DIF for each latent class indicator in a stepwise fashion. After integrating all significant DIF effects into the latent class model, classes were interpreted again based on the model-estimated class-specific item response probabilities. After identifying the final $K$-class model accounting for DIF, more specific hypotheses were formulated for Aims 2 and 3.

Aims 2 and 3 were addressed using latent class regression (LCR) models to investigate structural associations between covariates and exposure variables and latent class membership using the manual three-step approach, which accounts for uncertainty in class assignments (Asparouhov & Muthén, 2014). This was examined by comparing a constrained model with multinominal regression coefficients for the independent variable fixed to zero to an unconstrained model where they were freely estimated. A significant Wald test comparing these two models indicates that including the independent variable improves model fit (Masyn, 2013). To address Aim 2, a model examined the relations of sex, grade, racial-ethnic background, and intervention status with class membership. Next, the associations between exposure to community violence and nonviolent stressors (independent variables) and class membership (dependent variable) were examined (Aim 3a; see Figure 1). Models examined (a) associations with each exposure variable alone while controlling for covariates, and (b) the unique association
of each exposure variable while controlling for the other exposure variables and covariates. An additional model examined the relations of exposure to violent and nonviolent stressors and class membership while controlling for peer pressure for substance use, a strong predictor of adolescent alcohol use. Finally, several models examined the extent to which participant sex moderated the associations between witnessing community violence and physical victimization and class membership (Aim 3c).
Figure 1

*Graphical Representation of the Latent Class Regression Model with Demographic Covariates and Exposure Variables*

Note. $C =$ latent class.
Results

Descriptive Statistics

The frequency of responses on the four latent class indicators are reported in Table 1. The majority of the sample reported never using each form of alcohol in their lifetime (i.e., 53.7% - 73.7%). Participants were most likely to report having used wine and beer, followed by drinking liquor, and then getting drunk. Regarding past 30-day alcohol use, most youth reported drinking 1 to 2 times (i.e., 9.7% – 16%). Fewer adolescents reported more frequent alcohol use, such that the percentage of students endorsing response categories decreased as the frequency of alcohol increased.

Skewness and kurtosis were examined for measures of exposure to violence and nonviolent life stressors to assess normality of distributions. Four of seven scales had positively skewed and kurtotic distributions: witnessing violence, physical victimization, environmental stressors, and peer pressure for substance use (see Table 2). Scores on non-normal variables were log-transformed to increase their normality, and then multiplied by ten to enhance interpretation (i.e., to avoid working with small numbers). The log-transformed variables were used in all ensuing analyses. Four respondents with missing data on all four latent class indicators were excluded from analyses ($N = 5007$). Between 0.3% to 1.3% of data were missing on measures of exposure to violent and nonviolent stressors. All exposure variables were significantly positively correlated with one another at $p < .001$ (see Table 3). These ranged from small (e.g., peer pressure and peer provocation) to moderate (e.g., witnessing violence and physical victimization) in size. All but two of the 15 correlations were greater than .30, and five were .40 or higher.
### Table 1

**Percentage of the Sample Endorsing the Frequency Categories for Each Indicator**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Lifetime Use</th>
<th></th>
<th>Frequency of Past 30-day Use</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never</td>
<td>0</td>
<td>1-2</td>
<td>3-5</td>
</tr>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Drank Wine</td>
<td>2688</td>
<td>53.7%</td>
<td>778</td>
<td>15.6%</td>
</tr>
<tr>
<td>Drank Beer</td>
<td>2889</td>
<td>57.8%</td>
<td>666</td>
<td>13.3%</td>
</tr>
<tr>
<td>Drank Liquor</td>
<td>3625</td>
<td>72.3%</td>
<td>431</td>
<td>8.6%</td>
</tr>
<tr>
<td>Got Drunk</td>
<td>3682</td>
<td>73.7%</td>
<td>369</td>
<td>7.4%</td>
</tr>
</tbody>
</table>

*Note. N = 5011.*

### Table 2

**Descriptive Statistics for Measures of Exposure to Violence and Nonviolent Life Stressors**

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Skew</th>
<th>Kurtosis</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Witnessing Violence</td>
<td>8.32</td>
<td>3.29</td>
<td>2.17</td>
<td>5.54</td>
<td>6.00</td>
<td>24.00</td>
</tr>
<tr>
<td>Witnessing Violence (log*10)</td>
<td>8.95</td>
<td>1.38</td>
<td>1.26</td>
<td>1.08</td>
<td>7.78</td>
<td>13.80</td>
</tr>
<tr>
<td>Physical Victimization</td>
<td>6.81</td>
<td>1.60</td>
<td>2.41</td>
<td>7.84</td>
<td>4.00</td>
<td>16.00</td>
</tr>
<tr>
<td>Physical Victimization (log*10)</td>
<td>6.81</td>
<td>1.13</td>
<td>1.50</td>
<td>1.90</td>
<td>6.02</td>
<td>12.04</td>
</tr>
<tr>
<td>Exposure to Peer Provocation</td>
<td>9.53</td>
<td>4.30</td>
<td>1.19</td>
<td>1.00</td>
<td>5.00</td>
<td>25.00</td>
</tr>
<tr>
<td>Exposure to Unfair Situations</td>
<td>7.29</td>
<td>3.40</td>
<td>1.34</td>
<td>1.59</td>
<td>4.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Exposure to Environmental Stressors</td>
<td>6.05</td>
<td>2.01</td>
<td>3.59</td>
<td>19.55</td>
<td>5.00</td>
<td>25.00</td>
</tr>
<tr>
<td>Exposure to Environmental Stressors (log*10)</td>
<td>7.66</td>
<td>1.07</td>
<td>2.01</td>
<td>4.69</td>
<td>6.99</td>
<td>13.98</td>
</tr>
<tr>
<td>Peer Pressure for Substance Use</td>
<td>5.63</td>
<td>3.12</td>
<td>2.79</td>
<td>8.99</td>
<td>4.00</td>
<td>24.00</td>
</tr>
<tr>
<td>Peer Pressure for Substance Use (log*10)</td>
<td>7.09</td>
<td>1.69</td>
<td>1.69</td>
<td>2.20</td>
<td>6.02</td>
<td>13.80</td>
</tr>
</tbody>
</table>

*Note. Italics denote variables that were log transformed and multiplied by 10. Min = minimum. Max = maximum.*
Table 3

*Correlations among Independent Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Witnessing Violence*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Physical Victimization*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Peer Provocation</td>
<td>.20***</td>
<td>.40***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Unfair Situations</td>
<td>.38***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Environmental Stressors*</td>
<td>.32***</td>
<td>.35***</td>
<td>.44***</td>
<td>.34***</td>
<td></td>
</tr>
<tr>
<td>6. Peer Pressure for Substance Use*</td>
<td>.43***</td>
<td>.32***</td>
<td>.17***</td>
<td>.37***</td>
<td>.35***</td>
</tr>
</tbody>
</table>

*Based on log transformed score.*

***p < .001.

Latent Class Enumeration

*Progressive Elaboration Procedure*

**Step 1: Selection of Contender Models.** LCA indicator cut points were set such that ordinal categories for the four indicators corresponded with: never used in lifetime, initiated use and used 0 times in the past 30 days (0 P30D), and used more than 0 times in the past 30 days (>0 P30D). Proper solutions were obtained for models specifying between 1 and 6 classes (see Table 4). A seven-class model was attempted but did not yield a properly identified solution as indicated by a small condition number (Masyn, 2013). The five-class model had the lowest values for the BIC, SABIC and CAIC. Based on the LMR-LRT, the five-class model fit the data significantly better than the four-class model, and the fit was not further improved by the six-class model. The BLRT was significant in every case and thus did not inform model selection. The BF indicated that the five-class model had a greater probability of being correct than the six-class model. The five-class model also had the greatest probability of being correct based on the
### Table 4

**Model Fit Indices for K-Class Models with Trichotomous Indicators**

<table>
<thead>
<tr>
<th>K</th>
<th>LL</th>
<th>npar</th>
<th>LR χ²</th>
<th>df</th>
<th>p</th>
<th>AIC</th>
<th>BIC</th>
<th>SABIC</th>
<th>CAIC</th>
<th>AWE</th>
<th>RI (K, K+1)</th>
<th>LRTS</th>
<th>Adj LMR p</th>
<th>BLRT p</th>
<th>BF (K, K+1)</th>
<th>cmP (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-17110.87</td>
<td>8</td>
<td>174.96</td>
<td>71</td>
<td>&lt;.001</td>
<td>34237.75</td>
<td>34289.90</td>
<td>34264.48</td>
<td>34297.90</td>
<td>34382.05</td>
<td>na</td>
<td>6556.76</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>-13789.73</td>
<td>17</td>
<td>753.39</td>
<td>63</td>
<td>&lt;.001</td>
<td>27613.47</td>
<td>27724.28</td>
<td>27670.26</td>
<td>27741.28</td>
<td>27920.10</td>
<td>na</td>
<td>1952.06</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>-12800.98</td>
<td>26</td>
<td>331.64</td>
<td>54</td>
<td>&lt;.001</td>
<td>25653.95</td>
<td>25823.43</td>
<td>25740.81</td>
<td>25849.43</td>
<td>26122.92</td>
<td>0.30</td>
<td>173.07</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>-12713.31</td>
<td>35</td>
<td>185.17</td>
<td>45</td>
<td>&lt;.001</td>
<td>25496.62</td>
<td>25724.77</td>
<td>25613.56</td>
<td>25759.77</td>
<td>26127.93</td>
<td>0.03</td>
<td>99.23</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>-12663.05</td>
<td>44</td>
<td>84.65</td>
<td>54</td>
<td>&lt;.001</td>
<td>25414.10</td>
<td>25700.92</td>
<td>25561.10</td>
<td>25744.92</td>
<td>26207.74</td>
<td>0.02</td>
<td>29.98</td>
<td>0.09</td>
<td>&lt;.001</td>
<td>&gt;100</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>-12647.87</td>
<td>53</td>
<td>54.28</td>
<td>36</td>
<td>0.001</td>
<td>25401.73</td>
<td>25747.22</td>
<td>25578.80</td>
<td>25800.22</td>
<td>26357.70</td>
<td>0.00</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
</tbody>
</table>

*Note.* K number of latent classes, LL maximum likelihood value obtained for each model, Npar number of free parameters in the model. LR χ² likelihood ration chi-square goodness of fit statistic with degrees of freedom and p-value, AIC Akaike’s information criterion, BIC Bayesian information criterion, SABIC sample-size adjusted BIC, CAIC consistent Akaike’s information criterion, AWE average weight of evidence criterion, LRTS likelihood ration test statistic comparing row model with K classes to the model with K + 1 classes, Adj. LMR p adjusted Lo–Mendell–Rubin p-value for the LRTS, BLRT p parametric bootstrapped p-value for the LRTS, BF approximate Bayes factor comparing row model with k classes to model with K + 1 classes, cmP(K) approximate correct model probability for the row model with k classes compared with all other models in the table.

Values in bold for the AIC, BIC, SABIC, CAIC, and AWE indicate the model with the minimum value. Value in bold for the BF indicates the model with the smallest number of classes that is favored over a model with an additional class. Value in bold for the cmP(K) indicates values above 0.10. Values in box indicate the best fitting model.
cmP. The five-class model had an entropy of .82 and average posterior probabilities between .64 and .97, supporting classification precision and accuracy. OCC values between 18.84 and 65.03 suggested adequate separation and classification precision. Although the five-class model was determined to be the best model, the four- through six-class models were also considered contenders for the progressive elaboration approach.

**Step 2: Progressive Elaboration of Categorical Indicators.** The order for the sequential process of progressive elaboration was determined based on the percentage of the sample that had initiated each type of alcohol use: wine (46%), beer (42%), liquor (28%), and got drunk (26.5%; Table 1). Two models were tested for each indicator to determine where to add a third cut point to expand it from three-category to a four-category variable. The indicator categories were set at 1) never used and 2) initiated use and 0 P30D. Two options for the 3rd and 4th categories were evaluated. Option A set a cut point to differentiate between 1 or 2 times versus more than 2 times in the past 30 days (i.e., 1-2 P30D and >2 P30D, respectively). Option B differentiated between 1 to 5 times versus more than 5 times in the past 30 days (i.e., 1-5 P30D and >5 P30D, respectively). Because the highest two response options (i.e., 10-19 P30D, 20+ P30D) were endorsed by less than 4% of the sample on all four indicators (see Table 1), additional cut points were not evaluated.

Criteria to select an additional cut point were adapted from Donovan and Chung (2015). First, inclusion of a third cut point for an indicator required that all four resulting categories informed classification. That is, each of the four response categories of the indicator had to have a moderate to high conditional probability (p ≥ .5) in at least one latent class. Second, to establish adequate levels of certainty in individual assignment, models at each step of the progressive elaboration procedure had to exhibit a similar or higher entropy than a model with one less cut
point. Finally, the third cut point that resulted in the lowest BIC was considered the best model. That is, if the two models with cut points option A and B both met the first two criteria, the model with the lowest BIC was selected as the best model. The progressive elaboration models were tested independently for models with four, five, and six classes, such that the selection of cut points were allowed to differ across $K$-class models. Detailed interpretation of results is only reported for the five-class model (see Table A-1 in the appendix for fit indices), though the steps were completed for models with four through six classes.

**Frequency of Wine Consumption.** The initial comparison model was the $K$-class model with trichotomous indicators. Models with wine cut points set at options A and B with all other indicators remaining trichotomous both exhibited moderate to high conditional probabilities ($p > .50$) for each category in one or more latent class and a similar or higher entropy value than the comparison model. Cut points for wine were fixed at option B (i.e., cut between 1-5 P30D and > 5 P30D) for all subsequent models because it produced a lower BIC than option A.

**Frequency of Beer Consumption.** With the wine cut points fixed at option B and with liquor and drunk trichotomous, models were tested with cut points for beer set at options A and B. Both models met requirements for conditional probabilities and entropy. As with wine, cut points for beer were fixed at option B (i.e., cut between 1-5 P30D and > 5 P30D) for subsequent models because it resulted in a lower BIC than option A.

**Frequency of Liquor Consumption.** With the wine and beer cut points fixed and trichotomous cut points for drunk, models were tested with liquor cut points set at options A and B. Within both models the second response category (i.e., initiated, 0 P30D) did not exhibit a moderate conditional probability in any latent class. Because the criteria for adding a third cut point were not met, liquor was fixed as a trichotomous variable in subsequent models.
**Frequency of Getting Drunk.** With the wine, beer, and liquor cut points fixed, models were tested with drunk cut points set at options A and B. The second response category (i.e., initiated, 0 P30D) did not exhibit a moderate conditional probability in any latent class. Thus, the criteria for adding a third cut point were not met and drunk was fixed as a trichotomous variable.

**Step 3: Selection of Best Model.** In the final five- and six-class models, the wine and beer indicators each had four categories (i.e., never used, initiated and 0 P30D, 1-5 P30D, >5 P30D), whereas liquor and drunk indicators had three categories (i.e., never used, initiated + 0 P30D, >0 P30D). The four-class model retained the same cut points, with the exception of the wine indicator that was fixed at cut point option A (i.e., never used, initiated and 0 P30D, 1-2 P30D, >2 P30D).

The final models with four through six classes were compared based on fit statistics, class homogeneity and separation, class size, and evaluated based on theory and parsimony. The five-class model had the lowest values for the BIC, CAIC, and average weight of evidence criterion (see Table 5). The cmP index suggested a greater probability that the five-class model was the correct model. Although the AIC and SABIC supported the six-class model, the parsimony principle supported the five-class model. Further, the six-class model had a class that included less than 5% of the sample, which is below the recommended minimum class size (see Table 6). Inspection of classification diagnostics also suggested good classification quality, class homogeneity, and class separation for the five-class model. The average posterior probabilities for the five classes ranged from .80 to .97. OCC values ranged from 11.63 to 91.11. Class specific item response probabilities indicated that responses were largely homogeneous within each class and exhibited separation across classes (see Table 7).
Descriptions of each class are as follows from lowest to highest severity of alcohol use, with severity of use characterized by using forms of alcohol with higher average alcohol content, frequency of use, and drunkenness. As hypothesized, the subgroup representing the largest percentage of the sample (56.5%) had a high probability (p > .70) of never using any form of alcohol in their lifetime and was labeled Abstainers All (Abstainers). Response patterns indicated that most adolescents in this subgroup (79%) reported never consuming alcohol, whereas a small percentage (21%) of the subgroup had used a single type of alcohol. The second subgroup, Initiators of Wine & Beer (Initiators WB; 12.5%), had a high probability of having used wine and beer, but not in the past 30 days. This subgroup was heterogenous in their probability of having initiated using liquor and getting drunk. However, response patterns indicated that nearly half had initiated liquor use (49%) and getting drunk (47%), which is substantially higher than in the full sample (i.e., 9% and 7%, respectively).

The subgroup labeled Moderately Frequent Wine & Beer Users (Moderate WB; 10.3%) had moderate to high probabilities (p > .50) of reporting wine and beer consumption one to five times in the past 30 days, and high probabilities of never using liquor or getting drunk. Based on response patterns, most of these adolescents had used beer (82%) or wine (57%) one to five times in the past 30 days, whereas only 8% drank any form of alcohol more than five times. A small percentage of this subgroup reported drinking liquor (10%) or getting drunk (32%) in the past 30 days. Notably, the percentage of adolescents who reported drinking liquor in the past month is lower than that in the full sample (i.e., 19%), but the percentage of those who reported drinking wine, beer, and got drunk is higher than in the full sample (i.e., 31%, 29%, and 19%, respectively).
In contrast, the *Moderately Frequent Wine, Beer, Liquor Users, & Getting Drunk* subgroup (*Moderate WBLD; 12.0%) had moderate to high probabilities ($p > .5$) of drinking liquor and getting drunk, in addition to high probabilities of using beer and wine one to five times in the past 30 days. Response patterns indicated that most in this subgroup reported drinking wine (79%) and beer (85%) one to five times, and drinking liquor (74%) and getting drunk (66%) in the past 30 days. Over 85% used two or more types of alcohol in the past month. These percentages were much higher than in the full sample (see Table 7).

As hypothesized, the subgroup reporting the highest frequency of alcohol use represented the smallest proportion of the sample. This subgroup, *Highly Frequent Wine, Beer, Liquor Users & Getting Drunk* (*High WBLD, 8.6*%), had high probabilities of using beer and wine more than five times, drinking liquor, and getting drunk in the past 30 days. Response patterns demonstrated that 90% of this subgroup had consumed beer and wine more than five times in the past month, whereas only about 8% and 9% of the full sample drank beer or wine more than five times, respectively. Most in this class had reported using liquor (91%) and being drunk (84%) in the past month. The majority (82%) reported drinking beer, wine, and liquor in the past month, and about half (53%) reported also getting drunk.
Table 5

Model Fit Indices for K-Class Models that Emerged from the Progressive Elaboration Analyses

<table>
<thead>
<tr>
<th>K</th>
<th>LL</th>
<th>npar</th>
<th>LR χ²</th>
<th>df</th>
<th>p-value</th>
<th>AIC</th>
<th>BIC</th>
<th>SABIC</th>
<th>CAIC</th>
<th>AWE</th>
<th>cmp(K) across classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>-14268.74</td>
<td>43</td>
<td>342.88</td>
<td>100</td>
<td>&lt;.001</td>
<td>28623.48</td>
<td>28903.77</td>
<td>28767.14</td>
<td>28946.77</td>
<td>29399.07</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>-13972.27</td>
<td>54</td>
<td>226.83</td>
<td>89</td>
<td>&lt;.001</td>
<td>28052.55</td>
<td><strong>28404.55</strong></td>
<td>28232.96</td>
<td><strong>28458.55</strong></td>
<td><strong>29026.56</strong></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>-13935.52</td>
<td>65</td>
<td>153.33</td>
<td>78</td>
<td>&lt;.001</td>
<td><strong>28001.04</strong></td>
<td>28424.75</td>
<td><strong>28218.20</strong></td>
<td>28489.75</td>
<td>29173.46</td>
<td>0</td>
</tr>
</tbody>
</table>

Note. K number of latent classes, LL maximum likelihood value obtained for each model, Npar number of free parameters in the model. LR χ² likelihood ration chi-square goodness of fit statistic with degrees of freedom and p-value, AIC Akaike’s information criterion, BIC Bayesian information criterion, SABIC sample-size adjusted BIC, CAIC consistent Akaike’s information criterion, AWE average weight of evidence criterion, cmp(K) across classes correct model probability comparing the 4, 5, and 6 class models.

Values in bold for the AIC, BIC, SABIC, CAIC, and AWE indicate the model with the minimum value. Value in bold for the cmp(K) indicates values above 0.10.
Table 6

*Final Class Counts and Percentages for K-Class Models Based on Most Likely Latent Class Membership*

<table>
<thead>
<tr>
<th>Class</th>
<th>4-class solution</th>
<th>5-class solution</th>
<th>6-class solution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>1</td>
<td>534</td>
<td>10.7%</td>
<td>433</td>
</tr>
<tr>
<td>2</td>
<td>606</td>
<td>12.1%</td>
<td>517</td>
</tr>
<tr>
<td>3</td>
<td>903</td>
<td>18.0%</td>
<td>600</td>
</tr>
<tr>
<td>4</td>
<td>2964</td>
<td>59.2%</td>
<td>626</td>
</tr>
<tr>
<td>5</td>
<td>2831</td>
<td>56.5%</td>
<td>610</td>
</tr>
<tr>
<td>6</td>
<td>2831</td>
<td>56.5%</td>
<td></td>
</tr>
</tbody>
</table>

55
Table 7

Conditional Item Response Probabilities within the Full Sample and the Five-Class Model of Alcohol Use

<table>
<thead>
<tr>
<th>Variable</th>
<th>Response Category</th>
<th>Full sample (N = 5,007)</th>
<th>Abstainers All (56.5%)</th>
<th>Initiators WB (12.5%)</th>
<th>Moderate WB (10.3%)</th>
<th>Moderate WBLD (12%)</th>
<th>High WBLD (8.6%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beer</td>
<td>Never</td>
<td>.58</td>
<td>.96</td>
<td>.12</td>
<td>.33</td>
<td>.03</td>
<td>.03</td>
</tr>
<tr>
<td></td>
<td>Initiated, 0 P30D</td>
<td>.13</td>
<td>.04</td>
<td>.79</td>
<td>.03</td>
<td>.05</td>
<td>.03</td>
</tr>
<tr>
<td></td>
<td>1-5 P30D</td>
<td>.21</td>
<td>.00</td>
<td>.09</td>
<td>.62</td>
<td>.85</td>
<td>.11</td>
</tr>
<tr>
<td></td>
<td>&gt;5 P30D</td>
<td>.08</td>
<td>.00</td>
<td>.00</td>
<td>.02</td>
<td>.07</td>
<td>.84</td>
</tr>
<tr>
<td>Wine</td>
<td>Never</td>
<td>.54</td>
<td>.87</td>
<td>.13</td>
<td>.37</td>
<td>.05</td>
<td>.03</td>
</tr>
<tr>
<td></td>
<td>Initiated, 0 P30D</td>
<td>.16</td>
<td>.07</td>
<td>.77</td>
<td>.00</td>
<td>.15</td>
<td>.03</td>
</tr>
<tr>
<td></td>
<td>1-5 P30D</td>
<td>.22</td>
<td>.06</td>
<td>.09</td>
<td>.58</td>
<td>.76</td>
<td>.08</td>
</tr>
<tr>
<td></td>
<td>&gt;5 P30D</td>
<td>.09</td>
<td>.00</td>
<td>.01</td>
<td>.05</td>
<td>.04</td>
<td>.86</td>
</tr>
<tr>
<td>Liquor</td>
<td>Never</td>
<td>.73</td>
<td>.99</td>
<td>.50</td>
<td>.79</td>
<td>.15</td>
<td>.09</td>
</tr>
<tr>
<td></td>
<td>Initiated, 0 P30D</td>
<td>.09</td>
<td>.01</td>
<td>.44</td>
<td>.03</td>
<td>.18</td>
<td>.04</td>
</tr>
<tr>
<td></td>
<td>&gt;0 P30D</td>
<td>.19</td>
<td>.01</td>
<td>.06</td>
<td>.19</td>
<td>.67</td>
<td>.87</td>
</tr>
<tr>
<td>Drunk</td>
<td>Never</td>
<td>.74</td>
<td>.99</td>
<td>.53</td>
<td>.77</td>
<td>.20</td>
<td>.13</td>
</tr>
<tr>
<td></td>
<td>Initiated, 0 P30D</td>
<td>.07</td>
<td>.01</td>
<td>.43</td>
<td>.01</td>
<td>.08</td>
<td>.03</td>
</tr>
<tr>
<td></td>
<td>&gt;0 P30D</td>
<td>.19</td>
<td>.00</td>
<td>.04</td>
<td>.22</td>
<td>.72</td>
<td>.84</td>
</tr>
</tbody>
</table>

Note. P30D = past 30 day uses. Bolded values > .50 reflect a moderate to high probability of selecting a certain response given class membership.
Differential Item Functioning

The stepwise procedure recommended by Masyn (2017) was used to evaluate DIF by sex, grade, and racial-ethnic group. This seven-step procedure followed a sequential process, whereby significant DIF effects identified during each step were retained and further examined in subsequent steps. In Step 1, an omnibus test was used to determine if specifying nonuniform DIF for all items (i.e., allowing for differences in item functioning that vary across classes; all-DIF) improved model fit relative to the no-DIF model. If support was found for nonuniform DIF, follow-up tests were conducted in steps 2 to 4 to identify indicators for which there was evidence of either uniform or nonuniform DIF. These findings were used to create a partial-DIF model. The partial-DIF model was then examined to establish that it significantly improved upon the fit of the no-DIF model but did not significantly differ from the fit of the all-DIF model. Finally, a model with the identified uniform and nonuniform DIF effects was estimated and evaluated.

DIF by Sex. The model that allowed nonuniform DIF for all indicators (M1.1) fit the data significantly better than the no-DIF model (M1.0, see Appendix Table A-2). Initial tests supported DIF for all four indicator variables (see models 2.01 to 2.1.4 in Table A-2). Follow-up tests for each indicator supported nonuniform DIF for wine and drunk indicators and uniform DIF for beer and liquor indicators (M4.1 - M4.4 in Table A-2). Incorporating these effects into the no-DIF model (M5.0) resulted in uninterpretable relations of sex and wine across classes, such that response probabilities were fixed at zero for all response categories in one class. An alternative partial-DIF model (M5.1) with uniform DIF effects on wine, beer, and liquor variables and nonuniform DIF effects on the drunk variable was tested. This model fit significantly better than the no-DIF model (M1.0) but did not significantly decrease the fit
compared with the selective uniform DIF model (M3.0). These results justified selection of the alternative model M5.1.

Within the final model (M5.1 in Table A2), across all classes (i.e., uniform DIF), male adolescents were more likely than female adolescents to endorse more frequent beer use \( (OR = 1.57, p = .009, 95\% \text{ CI } [1.13, 2.35]) \), whereas female adolescents were more likely than male adolescents to endorse more frequent wine use \( (OR = 1.32, p = .014, 95\% \text{ CI } [1.02, 1.64]) \). Despite these differences, examination of the profiles with DIF effects for male and female adolescents suggested that they were substantively comparable (i.e., profiles would be interpreted similarly).

**DIF by Grade.** Comparisons of the model specifying nonuniform DIF for all indicators to the no-DIF model (see models 1.0 vs. 1.1 in Appendix Table A-3) supported DIF by grade. Individual follow-up tests for each indicator (M2.0.1 to 2.1.4 in Table A-3) provided evidence for nonuniform DIF for all indicators except the wine variable. A model incorporating selective nonuniform DIF effects of grade on these indicators (beer, liquor, drunk; M3.0) fit better than the model with no DIF (M1.0), and as well as the all-DIF model (M1.1). Follow-up tests supported uniform DIF for beer, liquor, and drunk variables. However, the model specifying uniform DIF for beer, liquor, and drunk (M5.0) did not fit as well as the model with all nonuniform DIF effects (M1.1). Alternative models were tested with 1) beer and drunk with uniform DIF and liquor with nonuniform DIF (M5.1), and 2) drunk with uniform DIF and liquor and beer with nonuniform DIF (M5.2). The latter model (M5.2) fit as well as the selective nonuniform DIF model (M3.0), justifying its selection as the final DIF by grade model.

Within the final model (M5.2), eighth graders had greater odds than sixth graders of endorsing getting drunk \( (OR = 2.02, p = .001, 95\% \text{ CI } [1.45, 2.82]) \) in all classes (uniform DIF).
Eighth graders in the following subgroups also had greater odds of endorsing more frequent liquor use: *High WBLD* (*OR* = 2.50, *p* = .046, 95% CI [1.10, 7.70]), *Initiators WB* (*OR* = 1.78, *p* = .020, 95% CI [1.09, 2.65]), and *Abstainers* (*OR* = 4.02, *p* = .013, 95% CI [1.30, 22.29]) classes. In contrast, there were no significant differences in the odds of item endorsement between sixth and seventh graders. Despite these differences, examination of the profiles with DIF effects by grade indicated that profiles for students in all grades would be interpreted similarly.

**DIF by Racial-Ethnic Background.** The model that allowed nonuniform DIF for all indicators (M1.1) did not significantly improve upon the fit of the no-DIF model (M1.0), suggesting no evidence of DIF by racial-ethnic group (see Appendix Table A-4). It was concluded that the no-DIF model best represented the data.

**Final Model Incorporating DIF**

Conditional item response probabilities for the five-class model accounting for identified DIF effects by sex and grade are reported in Table 8. No data were missing for grade, but cases with missing data on sex (*n* = 70) were listwise deleted, resulting in *N* = 4937. Compared with the unconditional five-class model (Table 7), including DIF effects resulted in several small changes in the magnitude of class proportions and conditional response probabilities. Based on their most likely class membership, the percentage of participants in *Moderate WB* increased slightly from 10.3% to 11.7% of the sample. In contrast, the *Moderate WBLD* class decreased from 12% to 10.9% and the *High WBLD* subgroup decreased from 8.6% to 7.7% of the sample. Overall patterns of response probabilities remained the same, such that response probabilities that were moderate (> .5) to high (> .7) were still moderate to high, whereas small probabilities (< .3) remained small.
### Table 8

*Conditional Item Response Probabilities within the Full Sample and the Five-Class Model of Alcohol Use Accounting for DIF*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Response Category</th>
<th>Full sample (N = 5,007)</th>
<th>Abstainers (56.9%)</th>
<th>Initiators (12.9%)</th>
<th>Moderate (11.7%)</th>
<th>Moderate (10.9%)</th>
<th>High (7.7%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beer</td>
<td>Never</td>
<td>.58</td>
<td>.97</td>
<td>.34</td>
<td>.45</td>
<td>.02</td>
<td>.04</td>
</tr>
<tr>
<td></td>
<td>Initiated, 0 P30D</td>
<td>.13</td>
<td>.03</td>
<td>.64</td>
<td>.01</td>
<td>.08</td>
<td>.06</td>
</tr>
<tr>
<td></td>
<td>1-5 P30D</td>
<td>.21</td>
<td>.01</td>
<td>.02</td>
<td>.54</td>
<td>.82</td>
<td>.27</td>
</tr>
<tr>
<td></td>
<td>&gt;5 P30D</td>
<td>.08</td>
<td>.00</td>
<td>.00</td>
<td>.01</td>
<td>.08</td>
<td>.63</td>
</tr>
<tr>
<td>Wine</td>
<td>Never</td>
<td>.54</td>
<td>.86</td>
<td>.13</td>
<td>.28</td>
<td>.05</td>
<td>.03</td>
</tr>
<tr>
<td></td>
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<td>.06</td>
<td>.74</td>
<td>.01</td>
<td>.16</td>
<td>.02</td>
</tr>
<tr>
<td></td>
<td>1-5 P30D</td>
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<td>.07</td>
<td>.12</td>
<td>.65</td>
<td>.78</td>
<td>.04</td>
</tr>
<tr>
<td></td>
<td>&gt;5 P30D</td>
<td>.09</td>
<td>.00</td>
<td>.01</td>
<td>.06</td>
<td>.02</td>
<td>.91</td>
</tr>
<tr>
<td>Liquor</td>
<td>Never</td>
<td>.73</td>
<td>1.00</td>
<td>.72</td>
<td>.90</td>
<td>.26</td>
<td>.22</td>
</tr>
<tr>
<td></td>
<td>Initiated, 0 P30D</td>
<td>.09</td>
<td>.00</td>
<td>.25</td>
<td>.03</td>
<td>.19</td>
<td>.06</td>
</tr>
<tr>
<td></td>
<td>&gt;0 P30D</td>
<td>.19</td>
<td>.00</td>
<td>.03</td>
<td>.08</td>
<td>.55</td>
<td>.72</td>
</tr>
<tr>
<td>Drunk</td>
<td>Never</td>
<td>.74</td>
<td>1.00</td>
<td>.75</td>
<td>.83</td>
<td>.32</td>
<td>.35</td>
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<td>Initiated, 0 P30D</td>
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<td>.24</td>
<td>.02</td>
<td>.08</td>
<td>.05</td>
</tr>
<tr>
<td></td>
<td>&gt;0 P30D</td>
<td>.19</td>
<td>.00</td>
<td>.01</td>
<td>.15</td>
<td>.61</td>
<td>.60</td>
</tr>
</tbody>
</table>

*Note. N = 4937. DIF = Differential item functioning. P30D = past 30-day uses. Bolded values > .50 reflect a moderate to high probability of selecting a certain response given class membership*
Formulating Hypotheses

After the identification of the final 5-class model accounting for DIF for sex and grade, the following hypotheses were formulated for the associations between covariates and exposure variables and latent class membership:

1. That sex would be associated with class membership, such that female adolescents would have greater odds of belonging to the two subgroups with lower severity of alcohol use (i.e., Abstainers WBLD, Initiators WB) than male adolescents, and male adolescents would have greater odds of belonging to the higher severity subgroups (i.e., High WBLD, Moderate WBLD) than female adolescents.

2. That grade would be related to class membership, such that sixth grade students would have greater odds of belonging to the Abstainers class than seventh and eighth grade students, and eighth and seventh grade students would have greater odds of being in in High WBLD and Moderate WBLD classes than sixth graders.

3. That racial-ethnic background would be associated with class membership. Specifically, that Black youth would have greater odds of being Abstainers than non-Latinx White and Latinx youth, and lower odds of being in High WBLD than White and Latinx youth. In contrast, it was expected that White youth would have greater odds of membership in High WBLD compared with Black and Latinx youth.

4. That witnessing community violence, physical victimization, and nonviolent stressors (i.e., environmental stress, peer provocation, unfair situations) would all be individually associated with class membership. Specifically, youth with higher levels of witnessing community violence, physical victimization, and the three types of nonviolent stressors would have greater odds of being in classes characterized by alcohol use relative to the Abstainers class.
also hypothesized that higher levels of exposure to violent and nonviolent stressors would relate to greater odds of membership in classes with more severe patterns of alcohol use, as evidenced by consumption of drinks with higher alcohol content, more frequent use, and getting drunk. Specifically, youth with higher exposure would have greater odds of being in High WBLD and Moderate WBLD relative to Initiators and Moderate WB. Further, youth with higher exposure levels would have greater odds of being in High WBLD versus Moderate WBLD, and Moderate WB versus Initiators WB.

5. Within analyses simultaneously examining relations between all exposure variables and class membership, I hypothesized that witnessing community violence and physical victimization would relate to class membership while controlling for nonviolent stressor variables. In this model, I hypothesized that witnessing community violence would be a stronger predictor of class membership (e.g., have a larger effect size) than physical victimization and nonviolent stressors. Additionally, I hypothesized that witnessing community violence, physical victimization, and nonviolent stressors would have significant associations with class membership after accounting for peer pressure for substance use.

6. That sex would moderate the relations of exposure to witnessing violence and physical victimization with class membership, such that exposure to witnessing violence and physical victimization would be more strongly related to increases in severity of alcohol use for female than for male adolescents.

**Latent Class Regression Analyses**

A series of analyses was conducted using the manual three-step approach, which uses multinominal regression analysis to examine predictors of class membership while adjusting for average uncertainty of class assignment in the model (Asparouhov & Muthén, 2014). The first
step was to complete the unconditional LCA that accounted for identified DIF effects. The second step involved creating a nominal variable representing the most likely class and computing probabilities for uncertainty in class assignment based on the estimated latent class model from Step 1. In Step 3 the most likely class variable was used as the latent class indicator with uncertainty rates fixed at the probabilities identified during Step 2. The covariates and exposure variables were then incorporated into the model. Cases with missing values on covariates (n = 94) and exposure variables (ns = 13 – 66) were listwise deleted. Consequently, sample sizes in the analyses ranged from 4757 to 4937. The significance of odds ratios was determined based on bias-corrected bootstrap estimates of confidence intervals.

**Covariates**

The relations between covariates (i.e., intervention status, sex, grade, racial-ethnic background) and class membership were examined. Class membership did not significantly differ based on the students’ participation in the intervention ($\chi^2 (4) = 6.52, p = .16$). Class membership significantly differed between male and female participants ($\chi^2 (4) = 35.11, p < .001$). As hypothesized, male adolescents had greater odds than female adolescents of being classified into *High WBLD* ($OR = 1.30, 95\% CI [1.05, 1.62]$) and had lower odds than female adolescents of being classified into *Abstainers* ($OR = .70, [.62, .80]$). Male participants also had greater odds of being in *Initiators WB* ($OR = 1.48, [1.22, 1.79]$). Confidence intervals indicated that the odds of membership in *Moderate WB* and *Moderate WBLD* did not significantly differ based on sex ($ORs = 1.24, .96, [.96, 1.57] [.74, 1.25]$, respectively). These results are reflected in estimated class proportions for male and female participants while controlling for racial-ethnic background, grade, and intervention status (see Figure 2).
Grade was also significantly related to class membership ($\chi^2 (8) = 227.70, p < .001$). The results partially supported the hypotheses. As hypothesized, seventh and eighth graders had lower odds than sixth graders of being in Abstainers ($ORs = .64, .37, [.55, .75], [.31, .43]$, respectively) and greater odds of being in Initiators WB ($ORs = 1.65, 3.78, [1.30, 2.14], [2.94, 4.87]$, respectively). There were no grade differences in membership in Moderate WB ($ORs = 1.20, .72, [.90, 1.63], [.51, 1.00]$, respectively, for 7th and 8th graders). Eighth graders had greater odds than sixth graders of being in Moderate WBLD ($OR = 1.96, [1.45, 2.68]$), but there was no significant difference between seventh and sixth graders ($OR = 1.11, [.78, 1.55]$). Finally, seventh and eighth graders both had greater odds than sixth graders of being in High WBLD ($ORs = 1.60, 2.02, 95\%$ CIs $[1.22, 2.19], [1.55, 2.72]$, respectively). These results are reflected in estimated class proportions across grades while controlling for sex, racial-ethnic background, and intervention status (see Figure 3).

Participants’ racial-ethnic background was significantly related to class membership ($\chi^2 (12) = 51.96, p < .001$). Although it was hypothesized that Black adolescents would have the greatest odds of being Abstainers, this was not the case ($ORs = .95, 1.17, 95\%$ CIs $[.81, 1.13], [.95, 1.45]$, for White and Latinx adolescents respectively). However, Black and Latinx adolescents had lower odds than White adolescents of being Initiators WB ($ORs = .53, .70, [.36, .72], [.54, .88]$, respectively). Racial-ethnic differences in the moderate severity classes were explored. Relative to White youth, Black and Latinx youth had greater odds of being in Moderate WB ($ORs = 2.16, 1.75, [1.51, 3.02], [1.28, 2.39]$, respectively), and Black adolescents had lower odds of being in Moderate WBLD ($OR = .39, [.18, .64]$). The hypothesis that Non-Latinx White youth would have the greatest odds of being in High WBLD was not supported. Relative to White students, Black and Latinx students did not differ in their odds of being in
High WBLD (ORs = 1.20, 1.09, [.82, 1.64], [.82, 1.43], respectively). They also did not differ from each other (OR = 1.10, [.75, 1.57]. These results are reflected in estimated class proportions across racial-ethnic group while controlling sex, grade, and intervention status (see Figure 4).

**Figure 2**

Proportion of Adolescents in Each Alcohol Use Class by Sex

![Bar chart showing proportions of adolescents in each class by sex.](chart)

Note. Class proportions calculated while controlling for grade, racial-ethnic group, and intervention status. Error bars represent 95% confidence intervals based on bias-corrected bootstrap estimates.
Figure 3

Proportion of Adolescents in Each Alcohol Use Class by Grade

Note. Class proportions calculated while controlling for sex, racial-ethnic group, and intervention status. Error bars represent 95% confidence intervals based on bias-corrected bootstrap estimates.
Figure 4

Proportion of Adolescents in Each Alcohol Use Class by Racial-Ethnic Background

Note. Class proportions calculated while controlling for sex, racial-ethnic group, and intervention status. Error bars represent 95% confidence intervals based on bias-corrected bootstrap estimates.
**Individual Associations of Exposure to Violence and Nonviolent Stressors and Class**

A series of five separate analyses was conducted for each variable of exposure to violent and nonviolent stressors while controlling for the covariates (i.e., sex, grade, race/ethnicity, intervention status). The exposure variables were standardized, and the covariates were grand mean centered to enhance interpretation. Odds ratios represent the increase in odds of class membership given a one standard deviation increase in each exposure variable. To correct for multiple comparisons, the Benjamini-Hochberg (1995) false discovery rate p-value correction was used within each model.

**Witnessing Community Violence.** As hypothesized, higher frequencies of witnessing violence were associated with membership in subgroups characterized by greater severity of alcohol use (see Table 9). Students reporting more frequent lifetime exposure to witnessing violence were at increased risk of being in each drinker classes compared with the Abstainer class. Based on the model estimates, adolescents who reported never witnessing violence (i.e., z = -.84) had a probability of .69 of being in the Abstainers class (see Figure 5). In contrast, the probability of being in the Abstainer class was .38 for those at one SD above the mean on the witnessing violence subscale (i.e., witnessing multiple acts of violence once or one act many times). Students who reported more frequent witnessing violence had greater odds of engaging in the most severe pattern of drinking (i.e, High WBLD) relative to lower-severity drinking. Students who had never witnessed violence had a probability of .03 of being High WBLD, whereas students at one SD above the mean had a probability of .14. Additionally, more frequent witnessing violence was associated with a greater risk of moderately frequent drinking plus liquor and drunkenness (Moderate WBLD) compared with drinking only wine and beer (Moderate WB) and no recent use (Initiators WB). The probability of class membership in
Moderate WBLD increased from .06 among students with zero lifetime exposure to .15 among those at one SD above the mean.

**Physical Victimization.** Higher frequencies of physical victimization were associated with membership in classes characterized by a greater severity of alcohol use (see Table 9). As hypothesized, students reporting more frequent lifetime exposure to physical victimization had increased odds of being in each of the drinker classes compared with Abstainers (see Figure 6). Model estimates indicated that students who never experienced physical victimization (i.e., \( z = -.70 \)) had a probability of .64 of being assigned to the Abstainers class. This was only .43 among students with one victimization experience (i.e., one SD above the mean; \( z = 1 \)). Students who reported more frequent victimization had greater odds of being in the highest severity drinking class (High WBLD) compared with lower severity drinking classes. Specifically, youth with zero physical victimization had a small probability of .04 of being in the High WBLD class. This increased to a probability of .12 among youth who were victimized one time. Finally, students with more frequent physical victimization had greater odds of being in subgroups with moderately frequent recent drinking and getting drunk (Moderate WBLD) compared with no drunkenness (Moderate WB) and no recent use (Initiators WB). Accordingly, the probability of membership in Moderate WBLD doubled from .07 among those with zero victimization to .14 among those with one victimization experience.

**Environmental Stressors.** More frequent exposure to environmental stressors was associated with greater odds of being in the two classes with the highest severity of alcohol use (i.e., High WBLD, Moderate WBLD; see Table 9) compared with abstinence, partially supporting the hypothesis. However, the frequency of environmental stressors was not related to differences in class membership representing patterns of less severe use (i.e., Moderate WB, Initiators WB).
Based on the model, students at the minimum value of environmental stressors (i.e., zero exposure; \( z = -0.62 \)), had a probability of 0.59 of being Abstainers (see Figure 7). This probability was lower (\( p = 0.50 \)) among students at one SD above the mean (i.e., two stressors once to twice per year or one stressor each month). More frequent environmental stress was associated with increased risk of being in the highest severity alcohol use class (i.e., High WBLD) compared with all lower severity classes. Students with zero environmental stressors had a 0.05 probability of being assigned to High WBLD, and this increased to 0.12 among students at one SD above the mean. Finally, more frequent exposure to environmental stressors related to increased risk of moderately frequent recent drinking and getting drunk (Moderate WBLD) versus recent drinking with no drunkenness (Moderate WB) and no recent use (Initiators WB). Model-based estimates indicated that the probability of being in Moderate WBLD increased from 0.08 among students at the bottom of the scale to 0.12 among students one SD above the mean.

**Unfair Situations.** As hypothesized, more frequent exposure to unfair situations was associated with greater odds of engaging in more severe patterns of alcohol use (see Table 9). Specifically, reporting a higher frequency of experiencing unfair situations was associated with being in all drinker classes compared with Abstainers. Based on the model, students who reported the minimum value of unfair situations (i.e., zero exposures; \( z = -0.97 \)) had a probability of 0.70 of being assigned to Abstainers (see Figure 8). This probability decreased to 0.39 among students at one SD above the mean (i.e., about several unfair situations per month to one situation almost daily). More frequent exposure to unfair situations was also associated with an increased risk of engaging in the highest severity pattern of alcohol use (i.e., High WBLD) versus all lower severity classes (Table 9). Students who reported no exposure to unfair situations had a 0.03 probability of being in High WBLD, and this increased to 0.13 for students at one SD above
the mean. Additionally, more frequent exposure to unfair situations was associated with greater odds of engaging in liquor and drunkenness (*Moderate WBLD*) versus only wine and beer use (*Moderate WB*). Specifically, model estimates indicated that the probability of membership in *Moderate WBLD* increased from .05 among students with zero exposures to .15 among those at one SD above the mean.

**Peer Provocation.** More frequent exposure to peer provocation was also associated with increased risk of alcohol use relative to abstinence, partially supporting the hypothesis (see Table 9). Specifically, students who reported the minimum value of peer provocation (i.e., zero exposures; $z = -1$) had a probability of .63 of being assigned to the *Abstainers* class (see Figure 9). This probability was lower ($p = .49$) among students at one SD above the mean (i.e., several provocations per week to two almost daily). The frequency of exposure to peer provocation did not impact the relative odds of membership in most classes characterized by similar levels of use (e.g., *High WBLD vs Mod WBLD*; see Table 9), with one exception. More frequent peer provocation was associated with greater odds of membership in *High WBLD versus Moderate WB*. Thus, model estimates indicated that the probability of membership in *High WBLD* increased from .06 among students at the bottom of the scale to .10 among the at one SD above the mean.
<table>
<thead>
<tr>
<th>Class Comparison</th>
<th>Witnessing Violence</th>
<th>Physical Victimization</th>
<th>Environmental Stressors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
<td>p</td>
</tr>
<tr>
<td>High WBLD vs Mod WBLD</td>
<td>1.44*</td>
<td>1.27</td>
<td>1.66</td>
</tr>
<tr>
<td>Mod WB</td>
<td>2.04*</td>
<td>1.78</td>
<td>2.38</td>
</tr>
<tr>
<td>Init WB</td>
<td>1.88*</td>
<td>1.66</td>
<td>2.14</td>
</tr>
<tr>
<td>Abstainers</td>
<td>3.29*</td>
<td>2.92</td>
<td>3.77</td>
</tr>
<tr>
<td>Mod WBLD vs Mod WB</td>
<td>1.42*</td>
<td>1.22</td>
<td>1.66</td>
</tr>
<tr>
<td>Init WB</td>
<td>1.31*</td>
<td>1.14</td>
<td>1.50</td>
</tr>
<tr>
<td>Abstainers</td>
<td>2.28*</td>
<td>2.02</td>
<td>2.60</td>
</tr>
<tr>
<td>Mod WB vs Init WB</td>
<td>0.92</td>
<td>0.80</td>
<td>1.06</td>
</tr>
<tr>
<td>Abstainers</td>
<td>1.61*</td>
<td>1.42</td>
<td>1.84</td>
</tr>
<tr>
<td>Init WB vs Abstainers</td>
<td>1.75*</td>
<td>1.55</td>
<td>1.98</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Unfair Situations</th>
<th>Peer Provocation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
</tr>
<tr>
<td>High WBLD vs Mod WBLD</td>
<td>1.22*</td>
<td>1.07</td>
</tr>
<tr>
<td>Mod WB</td>
<td>1.73*</td>
<td>1.50</td>
</tr>
<tr>
<td>Init WB</td>
<td>1.59*</td>
<td>1.41</td>
</tr>
<tr>
<td>Abstainers</td>
<td>2.73*</td>
<td>2.45</td>
</tr>
<tr>
<td>Mod WBLD vs Mod WB</td>
<td>1.42*</td>
<td>1.20</td>
</tr>
<tr>
<td>Init WB</td>
<td>1.30*</td>
<td>1.14</td>
</tr>
<tr>
<td>Abstainers</td>
<td>2.25*</td>
<td>2.00</td>
</tr>
<tr>
<td>Mod WB vs Init WB</td>
<td>0.92</td>
<td>0.78</td>
</tr>
<tr>
<td>Abstainers</td>
<td>1.58*</td>
<td>1.38</td>
</tr>
<tr>
<td>Init WB vs Abstainers</td>
<td>1.72*</td>
<td>1.53</td>
</tr>
</tbody>
</table>

*Statistical significance based on Benjamini-Hochberg FDR adjusted critical values for witnessing violence (p < .034), physical victimization (p < .034), environmental stressors (p < .028), peer provocation (p < .026), unfair situations (p < .027).

Note. OR = odds ratio for standardized estimates, 95% CI = bias-corrected bootstrapped estimates with 1000 bootstrap draws, p = p-value.
Figure 5

*Probability of Membership in Each Alcohol Use Class at Different Levels of Witnessing Violence*

Note. Probability calculated while controlling for sex, grade, race/ethnicity, and intervention status. -0.84 is the minimum standardized score on the log-transformed witnessing violence scale.
Figure 6

*Probability of Membership in Each Alcohol Use Class at Different Levels of Physical Victimization*

Note. Probability calculated while controlling for sex, grade, race/ethnicity, and intervention status. -0.7 is the minimum standardized score on the log-transformed physical victimization scale.
Figure 7

*Probability of Membership in Each Alcohol Use Class at Different Levels of Environmental Stressors*

Note. Probability calculated while controlling for sex, grade, race/ethnicity, and intervention status. -.62 is the minimum standardized score on the log-transformed environmental stressors scale.
Figure 8

*Probability of Membership in Each Alcohol Use Class at Different Levels of Unfair Situations*

Note. Probability calculated while controlling for sex, grade, race/ethnicity, and intervention status. -.97 is the minimum standardized score on the unfair situations scale.
Figure 9

Probability of Membership in Each Alcohol Use Class at Different Levels of Peer Provocation

Note. Probability calculated while controlling for sex, grade, race/ethnicity, and intervention status. -1.0 is the minimum standardized score on the peer provocation scale.
Unique Associations of Exposure to Violence and Nonviolent Stressors and Class

Two models examined the unique relations of each exposure variable’s relation with latent class membership, controlling for the other exposure variables. Model A included variables representing exposure to community violence, nonviolent stressors, and covariates (see Table 10). Wald tests indicated that each exposure variable maintained a significant association with class membership after controlling for the other types of exposures. This supported the hypothesis that each type of exposure to violent and nonviolent stressors would be uniquely related to class membership. Although not all pairwise comparisons were significant, results generally indicated that more frequent exposure to witnessing violence, physical victimization, and unfair situations was associated with alcohol use relative to abstinence, and greater severity of alcohol use relative to less severe alcohol use, as hypothesized. However, results for peer provocation and environmental stressors differed from what was hypothesized. With all other variables held constant, more frequent peer provocation was associated with greater odds of membership in Abstainers versus alcohol use classes (i.e., High WBLD, Moderate WBLD). Environmental stressors yielded inconsistent results. More specifically, more frequent exposure to environmental stressors was related to increased odds of membership in Abstainers relative to Moderate WB and Initiators WB, but also increased odds of membership in High WBLD relative to Moderate WB and Initiators WB.

As hypothesized, witnessing community violence was the strongest predictor of class membership. Examination of the 95% confidence intervals for the standardized odds ratios indicated that witnessing violence was a stronger predictor of membership in alcohol use classes than physical victimization in several cases (e.g., High WBLD vs Abstainers; Moderate WB vs Abstainers; see Table 10). This partially supported the hypothesis that witnessing community
violence would have a stronger association with adolescents’ pattern of alcohol use than physical victimization and nonviolent stressors.

Model B examined whether each exposure variable was associated with patterns of alcohol use after controlling for the frequency of peer pressure for substance use. Peer pressure for substance use was associated with greater odds of membership in alcohol use classes relative to the Abstainers class and was associated with the largest effect sizes in the model when comparing the alcohol use classes with Abstainers (ORs = 2.52 – 14.14; see Table 10). After accounting for peer pressure for substance use, all omnibus tests of associations of exposure to community violence and nonviolent stressors variables with class membership remained significant. Pairwise comparisons partially supported the hypothesis, such that exposure variables differentiated between alcohol use classes and Abstainers. As in Model A, higher levels of exposure to witnessing violence, physical victimization, and unfair situations were associated with greater odds of being in alcohol use classes relative to Abstainers. Additionally, higher levels of peer provocation and environmental stressors were associated with lower odds of membership in several alcohol use classes relative to Abstainers. However, the exposure variables often did not significantly impact the odds of membership in classes with similar severity of alcohol use (e.g., High WBLD vs Mod WBLD; Mod WBLD vs Mod WB) after controlling for peer pressure to use substances. For example, in Model A higher levels of physical victimization and witnessing violence accounted for greater odds of membership in High WBLD versus Moderate WBLD, whereas in Model B neither of these variables was associated with significant differences in the odds of membership in these classes.
### Table 10

**Odds Ratios for the Unique Effects of Variables Representing Exposure to Stressors on Class Membership**

<table>
<thead>
<tr>
<th>Variable</th>
<th>High WBLD vs Mod WBLD</th>
<th>High WBLD vs Mod WB</th>
<th>High WBLD vs Init WB</th>
<th>High WBLD vs Abstainers</th>
<th>Mod WBLD vs Mod WB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR  95% CI</td>
<td>OR  95% CI</td>
<td>OR  95% CI</td>
<td>OR  95% CI</td>
<td>OR  95% CI</td>
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<tr>
<td><strong>Model A</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peer Provocation⁴</td>
<td>1.02 0.83 1.25</td>
<td>0.67* 0.54 0.82</td>
<td>0.73* 0.61 0.87</td>
<td>0.77* 0.64 0.90</td>
<td>0.65* 0.50 0.83</td>
</tr>
<tr>
<td>Unfair Situations⁴</td>
<td>1.02 0.87 1.20</td>
<td>1.40* 1.19 1.67</td>
<td>1.32* 1.14 1.56</td>
<td>1.92* 1.69 2.21</td>
<td>1.38* 1.12 1.72</td>
</tr>
<tr>
<td>Environmental Stressors⁴</td>
<td>1.12 0.94 1.33</td>
<td>1.49* 1.23 1.83</td>
<td>1.39* 1.18 1.63</td>
<td>1.20* 1.05 1.38</td>
<td>1.33* 1.05 1.74</td>
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<tr>
<td>Witnessing Violence⁴</td>
<td>1.34* 1.15 1.57</td>
<td>1.57* 1.34 1.85</td>
<td>1.55* 1.34 1.82</td>
<td>2.27* 1.99 2.63</td>
<td>1.17* 0.98 1.39</td>
</tr>
<tr>
<td>Physical Victimization⁴</td>
<td>1.06* 0.90 1.24</td>
<td>1.43* 1.20 1.71</td>
<td>1.18* 1.02 1.38</td>
<td>1.64* 1.42 1.87</td>
<td>1.35* 1.11 1.65</td>
</tr>
<tr>
<td><strong>Model B</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peer Provocation⁴</td>
<td>1.07 0.88 1.32</td>
<td>0.72* 0.58 0.88</td>
<td>0.80 0.66 1.01</td>
<td>0.85* 0.68 1.03</td>
<td>0.67* 0.52 0.85</td>
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<tr>
<td>Unfair Situations⁴</td>
<td>0.97 0.81 1.15</td>
<td>1.29* 1.07 1.54</td>
<td>1.15 0.95 1.36</td>
<td>1.57* 1.31 1.88</td>
<td>1.33* 1.08 1.66</td>
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<tr>
<td>Environmental Stressors⁴</td>
<td>0.93 0.78 1.10</td>
<td>1.11 0.92 1.37</td>
<td>0.96 0.80 1.15</td>
<td>0.76* 0.64 0.91</td>
<td>1.19 0.96 1.50</td>
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<tr>
<td>Witnessing Violence⁴</td>
<td>1.15 0.97 1.39</td>
<td>1.27* 1.06 1.56</td>
<td>1.19 1.00 1.46</td>
<td>1.61* 1.36 1.95</td>
<td>1.10 0.89 1.35</td>
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<tr>
<td>Physical Victimization⁴</td>
<td>0.95 0.79 1.12</td>
<td>1.26* 1.06 1.51</td>
<td>0.98 0.82 1.18</td>
<td>1.35* 1.14 1.61</td>
<td>1.33* 1.10 1.64</td>
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<tr>
<td>Peer Pressure for Substance Use⁴</td>
<td>2.12* 1.80 2.55</td>
<td>2.67* 2.22 3.34</td>
<td>5.60* 4.63 7.18</td>
<td>14.14* 11.01 19.75</td>
<td>1.26* 1.02 1.56</td>
</tr>
<tr>
<td></td>
<td>Mod WBLD vs Init WB</td>
<td>Mod WBLD vs Abstainers</td>
<td>Mod WB vs Init WB</td>
<td>Mod WB vs Abstainers</td>
<td>Init WB vs Abstainers</td>
</tr>
<tr>
<td>---------------------------</td>
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</tr>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
<td>OR</td>
<td>95% CI</td>
<td>OR</td>
</tr>
<tr>
<td>Peer Provocation&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.72*</td>
<td>0.58-0.87</td>
<td>0.75*</td>
<td>0.62-0.88</td>
<td>1.10</td>
</tr>
<tr>
<td>Unfair Situations&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.30*</td>
<td>1.11-1.54</td>
<td>1.89*</td>
<td>1.64-2.21</td>
<td>0.94</td>
</tr>
<tr>
<td>Environmental Stressors&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.25*</td>
<td>1.04-1.50</td>
<td>1.08</td>
<td>0.93-1.25</td>
<td>0.94</td>
</tr>
<tr>
<td>Witnessing Violence&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.15*</td>
<td>0.98-1.37</td>
<td>1.69*</td>
<td>1.47-1.96</td>
<td>0.99*</td>
</tr>
<tr>
<td>Physical Victimization&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.12*</td>
<td>0.96-1.32</td>
<td>1.55*</td>
<td>1.34-1.79</td>
<td>0.83*</td>
</tr>
</tbody>
</table>

|                           | OR      | 95% CI    | OR      | 95% CI    | OR      | 95% CI    | OR      | 95% CI    | OR      | 95% CI    |
| Peer Provocation<sup>a</sup> | 0.75*   | 0.61-0.93 | 0.79*   | 0.64-0.95 | 1.11    | 0.92-1.33 | 1.18    | 0.98-1.39 | 1.06    | 0.90-1.21 |
| Unfair Situations<sup>a</sup> | 1.19    | 0.99-1.41 | 1.63*   | 1.38-1.93 | 0.89    | 0.74-1.07 | 1.22*   | 1.03-1.47 | 1.37*   | 1.19-1.59 |
| Environmental Stressors<sup>a</sup> | 1.03    | 0.85-1.23 | 0.82*   | 0.70-0.96 | 0.86    | 0.71-1.05 | 0.69*   | 0.56-0.81 | 0.80*   | 0.70-0.91 |
| Witnessing Violence<sup>a</sup> | 1.04    | 0.87-1.23 | 1.40*   | 1.19-1.66 | 0.94    | 0.78-1.12 | 1.27*   | 1.09-1.48 | 1.36*   | 1.17-1.57 |
| Physical Victimization<sup>a</sup> | 1.03    | 0.87-1.23 | 1.42*   | 1.21-1.68 | 0.78*   | 0.65-0.92 | 1.07    | 0.90-1.25 | 1.38*   | 1.21-1.58 |
| Peer Pressure for Substance Use<sup>a</sup> | 2.64*   | 2.20-3.25 | 6.67*   | 5.24-8.90 | 2.10*   | 1.71-2.61 | 5.30*   | 4.09-7.33 | 2.52*   | 1.98-3.37 |

<sup>a</sup> = significant Wald test

* = significant OR based on Benjamini-Hochberg FDR calculated critical values of .031 for Model A and .026 for Model B.

Note. OR = odds ratios for standardized estimates, 95% CIs = bias-corrected bootstrapped estimates with 1000 bootstrap draws.

Calculated in model including covariates of sex, grade, race/ethnicity, intervention status.
Moderation of Exposure to Violence by Sex

The extent to which sex moderated the relation between violence exposure (i.e., witnessing, and physical victimization) and class membership was examined in models that assumed consistent relations between other exposure variables and class membership across sex (i.e., potential moderating effects of sex on relations between nonviolent stressors and class membership were not examined). Interaction terms between violence exposure variables and participant sex were computed and incorporated into Model B, which also included the covariates and nonviolent exposure variables. Although the Wald test did not support a significant Sex x Witnessing Violence interaction effect on class membership ($\chi^2(4) = 5.81$, $p = .214$), sex did significantly moderate the relation between physical victimization and class membership ($\chi^2(4) = 9.77$, $p = .045$). Examination of odds ratios indicated that there was a significant sex difference in the association between physical victimization and membership in Moderate WB and Initiators WB compared with membership in the Abstainers class. Specifically, there was a stronger association between physical victimization and membership in the Moderate WB and Initiators WB versus Abstainers for female adolescents than for male adolescents. No other class comparisons were significant.

As displayed in Figure 10, at about one SD below the mean of physical victimization (i.e., zero victimization), female adolescents had a greater probability of being in Abstainers (.59) than male adolescents (.50). However, that pattern reversed itself at higher frequencies of victimization such that female adolescents were increasingly less likely than male adolescents to be Abstainers (i.e., .33 v. .41 for male and female adolescents, respectively at 2 SDs above the mean). The opposite trend occurred for membership in Moderate WB and Initiators WB. Whereas male youth were less likely to be in Moderate WB with more frequent victimization
(i.e., .23 to .16 at 2 SDs above the mean), female adolescents were more likely to be in Moderate WB (i.e., .17 to .21). Female adolescents were increasingly more likely than male adolescents to be in Initiators WB, such that the increase was greater for female adolescents (i.e., .12 to .26) than male adolescents (i.e., .17 to .26). These results partially support the hypothesis that exposure to physical victimization would predict greater increases in severity of alcohol use for female versus male adolescents. The findings indicate that female adolescents who experienced more physical victimization were less likely to remain abstinent, and more likely to initiate drinking or drink wine and beer one to five times in a month compared with male adolescents.
Figure 10

Probability of Membership in Each Alcohol Use Class at Different Levels of Victimization across Sex

Note. Probabilities calculated while controlling for sex, grade, racial-ethnic group, and intervention status. -.7 is the minimum observed score on the log-transformed physical victimization scale.
Discussion

The adverse outcomes associated with early initiation of alcohol use highlight the need to better understand heterogeneity in early adolescents’ alcohol use and factors that place them at risk for alcohol use. The first aim of this study was to describe heterogeneity in self-reported alcohol use among middle school students. A second aim was to determine whether class membership varied based on participants' sociodemographic characteristics. The third aim was to determine whether exposure to community violence and nonviolent stressors was associated with alcohol use class membership. This study addressed gaps in the literature by using mixture modeling best practices to identify patterns of alcohol use among early adolescents based on categorical indicators for multiple types of alcohol use. It also provided a new perspective on the association of violence exposure with adolescents’ alcohol use by controlling for nonviolent stressors. Among a racially and ethnically diverse sample of rural middle school students, five alcohol use classes were identified: Abstainers (56.5%), Initiators of Wine and Beer (12.5%), Moderately Frequent Wine and Beer Users (10.3%), Moderately Frequent Wine, Beer, Liquor Users and Getting Drunk (12%), Highly Frequent Wine, Beer, Liquor Users and Getting Drunk (8.6%). There were sex, grade, and racial-ethnic differences in class membership. Class membership was also related to exposure to physical victimization and witnessing violence, such that more frequent exposure was associated with a greater likelihood that adolescents would engage in higher severity patterns of alcohol use. Witnessing community violence and physical victimization were associated with alcohol use class while controlling for peer pressure for substance use. Finally, physical victimization had a stronger relation with alcohol use than for female than male adolescents. These findings have important implications for research and prevention of early adolescent alcohol use.
Latent Classes of Alcohol Use

The first aim of this study was to describe heterogeneity in self-reported alcohol use among middle school students using a finite number of discrete alcohol use classes. This built upon prior research by considering adolescents’ lifetime and recent frequency of different types of alcohol use and getting drunk as indicators of overall severity of alcohol use. The LCA supported a five-class model. As hypothesized, classes differed in lifetime and 30-day use of different types of alcohol and drunkenness. The five classes represented adolescents who abstained from all alcohol use (Abstainers, 56.9%), initiated wine and beer use (Initiators WB, 12.9%), drank wine and beer one to five times, but abstained from liquor and getting drunk in the past 30 days (Moderate WB, 11.7%), drank wine and beer one to five times, and drank liquor and got drunk in the past 30 days (Moderate WBLD, 10.9%), and those who drank wine and beer more than five times, and drank liquor and got drunk in the past 30 days (High WBLD, 7.7%).

The current study expanded upon prior research in several ways. It included indicators for three alcohol types that differ in their alcohol content (i.e., wine, beer, liquor), and response categories that included both lifetime and past 30-day alcohol use. Additionally, this study used the “progressive elaboration” approach (Donovan & Chung, 2015) to arrive at empirically derived indicator categories that best differentiated between latent classes. The findings diverged from past studies that typically identified three or four alcohol use classes (e.g., Dauber et al., 2009; Donovan & Chung, 2015; Reboussin et al., 2006; Jackson et al., 2014; Gohari et al., 2020). In contrast to prior studies that have not differentiated between classes of alcohol initiators and recent drinkers, this study identified a subgroup that reported lifetime drinking but none in the past 30 days (Initiators WB, 12.9%). It also differed from prior research by including indicators for different types of alcohol and getting drunk. This enabled identification of two unique classes.
of alcohol users. Both reported drinking wine and beer in the past 30-days (i.e., Moderate WB; Moderate WBLD), but only Moderate WBLD reported drinking liquor and getting drunk. These findings underscore the importance of considering different types of alcohol, as well as lifetime initiation and frequency of recent alcohol use, as important indicators of an adolescents’ overall severity of use.

The use of empirically derived cut points for categorical indicators enabled the present study to describe more heterogeneity in the frequency and overall severity of adolescents’ alcohol use while maintaining good model fit and parsimony. Interestingly, these results suggested that youth who drank wine and beer three to five times in the past month were more similar in overall response patterns to those who drank one to two times than to those who drank more than five times. In contrast, for drinking liquor and drunkenness, the results indicated that it was sufficient to differentiate between those that reported no use versus those that reported any use. These findings suggest that drinking more than five times in the past month and any liquor use were important indicators that an adolescent in this sample was engaging in high severity drinking relative to their peers.

The inclusion of separate indicators of different types of alcohol and categorical variables for alcohol use frequency also had implications for the overall severity of alcohol use patterns. The classes that reported drinking liquor (i.e., Mod WBLD, High WLBD) or drinking more than five times in the past month (i.e., High WBLD) also reported getting drunk in the past month. This is consistent with prior findings that drinking liquor is associated with heavy drinking and getting drunk (Dauber et al., 2009; Donovan & Chung, 2015; Maldonado-Molina et al., 2010; Smart & Walsh, 1995). This highlights the increasing severity of alcohol use that accompanies drinking on a weekly basis or drinking beverages with a high percentage of alcohol content, such
as hard liquor. It is vital to consider increasing frequency of alcohol use and different types of alcoholic beverages when attempting to characterize adolescents’ overall severity of use. The finding that endorsing drinking liquor or drinking more than five times in 30 days is a characteristic of the most severe subgroup of middle school drinkers, suggests they require intervention for alcohol use, regardless of whether they meet criteria for an alcohol use disorder.

Despite the use of different methods, several findings replicated those from past studies examining patterns of adolescents’ alcohol use. As hypothesized, the *Abstainers* class represented the largest percentage of early adolescents (i.e., 57% of the sample). This is consistent with prior studies that found 50% or more of adolescent samples reported no lifetime alcohol use (Dauber et al., 2009; Donovan & Chung, 2015; Khan et al., 2014). The subgroup of youth characterized by the greatest severity of alcohol use represented the smallest percentage of the current sample (i.e., *High WBLD, 7.7%*). This is consistent with prior studies that found that youth who drank more than once per week represented less than 10% of the sample (Dauber et al., 2009; Donovan & Chung, 2015; Gohari et al., 2020).

Prior studies identified classes of adolescents similar to the current study’s *Moderate WB* subgroup, which represented youth who drank one to five times in the past month but abstained from getting drunk. For example, in a national sample of youth in grades 7 through 12, Donovan and Chung (2015) found that 17% drank less than weekly and did not get drunk. Similarly, Dauber et al., (2009) found that about 20% of female youth in a national sample drank once per month but never got drunk. It is notable that the percentage of youth in the *Moderate WB* class (i.e., 11.7%) was lower than in prior studies of older adolescents (grades 7 – 12). This is likely attributable to age differences in alcohol use (Johnston et al., 2021). However, similarities in these patterns of use across studies indicates that some adolescents drink alcohol in lower
quantities, such that they have not gotten drunk in their lifetime. Because early initiation of
drunkenness has been shown to relate to engagement in problem behaviors and problem drinking
(Kuntsche et al., 2013; Warner et al., 2007), this suggests that the Moderate WB subgroup may
be engaging in less problematic alcohol use relative to their peers who are getting drunk (i.e.,
Moderate WBLD, High WBLD). However, the relative influence of these patterns of alcohol use
on adolescent functioning remains unknown because examining outcomes was not within the
scope of the present study. This has been the focus of prior work (e.g., Khan et al., 2014; Wells
et al., 2004), and future research should continue to examine how adolescents’ patterns of
alcohol use relate to various psychosocial outcomes.

**Individual Characteristics and Alcohol Use Classes**

The second aim of this study was to determine whether class membership varied based on
sex, grade, and racial-ethnic background. Tests for DIF revealed sex differences in several
alcohol use indicators. Male adolescents in all classes were less likely than female adolescents to
report more frequent wine use and more likely to report more frequent beer use. These findings
align with demographic trends indicating that female youth tend to use wine or wine coolers
more frequently, whereas male youth tend to drink beer more frequently (Johnston et al., 2018).
In the highest severity class, male adolescents were more likely to report drunkenness. This
corresponds with past findings that male youth increase heavy drinking at a faster rate than
female youth (Chen & Jacobson, 2012).

There were also sex differences in class membership. As hypothesized, male adolescents
were more likely than female adolescents to engage in the highest severity pattern of alcohol use
(High WBLD), and less likely to abstain from alcohol use. These differences are consistent with
prior research showing that male adolescents are more likely to engage in the most frequent and
highest-risk patterns of alcohol use (Donovan & Chung, 2015; Gohari et al., 2020; Khan et al., 2014; Reboussin et al., 2006; Jackson et al., 2014). Contrary to the hypothesis, male adolescents were more likely to belong to the subgroup that had only initiated wine and beer use. No sex differences were found in subgroups characterized by moderately frequent alcohol use (i.e., Moderate WB, Moderate WBLD). In sum, male adolescents were more likely than female adolescents to have initiated use and engaged in highly frequent use, but there was no sex difference in the likelihood of belonging to subgroups with moderately frequent alcohol use. These patterns align with findings that more male youth initiate alcohol use during early adolescence (Johnston et al., 2018; Kann et al., 2018) and accelerate their alcohol use more quickly after initiation than female youth (Chen & Jacobson, 2012; Wittchen et al., 2008). Male early adolescents may thus be at higher risk than female adolescents for initiating alcohol use during middle school and engaging in the highest severity patterns of alcohol use.

The alcohol use indicators also functioned differently (i.e., DIF) based on grade. Eighth grade students in all subgroups were more likely to report getting drunk, and those in Abstainers, Initiators WB, and High WBLD were more likely to endorse drinking liquor. There were also grade differences in class membership. As hypothesized, sixth graders were more likely than seventh and eighth graders to abstain from all alcohol use. Eighth graders were more likely than sixth and seventh graders to be assigned to the class that had initiated wine and beer use (Initiators WB). Interestingly, students in all grades were equally likely to be in the class that drank wine and beer one to five times in the past 30 days (Moderate WB), but eighth graders were more likely than sixth graders to be in classes that also drank liquor and got drunk (Moderate WBLD) or drank more than five times (High WBLD), supporting the hypothesis.
These findings are consistent with prior studies showing that younger adolescents are more likely to abstain from alcohol use (Dauber et al., 2009; Donovan & Chung, 2015). However, the present study expanded the literature by finding evidence of age differences across grades in middle school. In the current sample, 60% of eighth grade students had initiated some alcohol use, whereas only 45% and 23% of seventh and sixth grade students had done so, respectively. This is similar to national estimates for the time these data were collected. About 55% of eighth grade students in the late-1990’s had drunk alcohol in their lifetime (Johnston et al., 2021). Overall, the findings suggest that adolescents are increasingly likely to initiate alcohol use throughout middle school. Compared with younger drinkers, more eighth grade drinkers had begun drinking alcohol with a higher alcohol content, drinking alcohol more frequently, and using heavier levels that led to getting drunk. Future research using longitudinal methods are needed to examine how these patterns of alcohol use change over time during middle school.

Regarding racial-ethnic differences, it was hypothesized that Black youth would be more likely to remain abstinent from alcohol use compared with Latinx and White youth, and that White youth would be more likely to engage in the most severe pattern of alcohol use. However, the only significant differences were that Black and Latinx adolescents were more likely than other youth to be in the class that engaged in moderately frequent wine and beer use (i.e., Moderate WBLD), and Black adolescents were less likely to be in the class that also drank liquor and got drunk (i.e., Moderate WBLD). These findings suggests that Black youth who drink alcohol may be less likely also to use liquor and get drunk, which is consistent with national trends (Johnston et al., 2018). No racial-ethnic differences were found for membership in subgroups at the extremes of alcohol use severity (i.e., Abstainers, High WBLD), which differs from prior findings that Black and African American adolescents are more likely to abstain or
engage in less frequent alcohol use, whereas White adolescents are more likely to engage in heavier and more frequent patterns of alcohol use (e.g., Donovan & Molina, 2013; Donovan & Chung, 2015; Dauber et al., 2009, 2011; Khan et al., 2014).

These unexpected findings regarding racial-ethnic differences may be explained by the present study’s rural sample. Most prior studies have been based on nationally representative samples. Although non-White adolescents may be less likely to engage in alcohol use based on national samples, this difference has not been found in the few studies that have examined racial-ethnic differences among rural samples. For example, a study in rural Georgia found that African American and White youth engaged in alcohol use at similar rates during early adolescence (Dickens et al., 2018). Another study examining data from Monitoring the Future found that students attending schools with a majority African American sample had lower rates of alcohol use than schools with more than 66% White students (O’Malley et al., 2006), suggesting that race and ethnic differences may differ based on the racial composition of the locality due to peer influences and norms. There is also evidence that the impact of risk and protective factors on alcohol use might vary between African American youth in urban and rural settings (Clark et al., 2011). The current findings regarding racial-ethnic differences in patterns of alcohol use point to the limits of generalizing nationally representative data to a specific subset of the population. It is important to examine between- and within-group differences in adolescents’ alcohol use due to the potential implications for prevention. Whereas relying solely on national data might lead to the conclusion that African American and Black early adolescents are at lower risk for severe alcohol use relative to their White and Latinx counterparts, the current findings suggest that they may be at similar levels of risk for problematic patterns of alcohol use in the rural Southeastern U.S.
Exposure to Community Violence and Nonviolent Stressors and Alcohol Use Classes

The third aim of this study was to determine the extent to which exposure to community violence and nonviolent stressors were associated with membership in alcohol use classes. When each variable was examined individually, the findings supported the hypothesis that higher levels of exposure to community violence (i.e., witnessing, physical victimization) and nonviolent stressors (i.e., environmental, unfair situations, peer provocation) were related to more severe patterns of alcohol use. In particular, higher frequencies of witnessing community violence and physical victimization were each associated with a greater likelihood of membership in subgroups characterized by greater severity of alcohol use, relative to subgroups with relatively lower severity use. These findings are consistent with the stress-coping model of alcohol use (Wills & Clearly, 1995; Wills & Filer, 1996) and prior research indicating positive relations between exposure to community violence and alcohol use initiation and frequency (e.g., Bossarte & Swahn, 2008; Sartor et al., 2018; Schwab-Stone et al., 1995; Wright et al., 2013; Zimmerman & Kushner, 2017). Similar patterns were present for exposure to the three types of nonviolent stressors, but to a lesser extent. Higher levels of nonviolent stressors were significantly associated with membership in alcohol use subgroups versus abstinence but did not consistently differentiate between substance use subgroups (e.g., Initiators WB vs. Moderate WB).

The second focus of this aim was to examine the relative associations of exposure to different types of violent and nonviolent life stressors with adolescents’ alcohol use. Controlling for all of these types of stressors did not change the findings for witnessing violence, physical victimization, and unfair situations. As in the separate analyses of each variable, witnessing community violence and physical victimization were each uniquely related to membership in higher severity alcohol classes after accounting for each other and for all three forms of
nonviolent life stressors (i.e., environmental stress, peer provocation, unfair situations). As in the individual analysis, more frequent exposure to unfair situations (e.g., teacher punishes you unfairly, an adult lies about you) was also uniquely related to more severe patterns of alcohol use. Although peer provocation and environmental stressors were related to a greater likelihood of being in alcohol use subgroups when examined in individual models, their relations with alcohol use patterns differed in models that controlled for the full set of exposure variables. More frequent exposure to peer provocation related to greater likelihood of abstinence compared with alcohol use. Environmental stressors showed mixed results, such that more frequent exposure related to a greater likelihood of abstinence, or engaging in the most severe patterns of drinking (i.e., High WBLD), relative to moderate drinking (i.e., Mod WB).

This study differed from prior studies by examining the associations between exposure to witnessing violence and physical victimization and adolescents’ alcohol use in a rural sample, and by accounting for nonviolent stressors. The findings for witnessing violence, physical victimization, and unfair situations were consistent with stress-coping models of alcohol use (Wills & Filer, 1996), which suggest that CVE and unfair stressful situations can cause significant distress for adolescents and therefore contribute to engaging in more severe alcohol use. This is also consistent with prior findings that witnessing violence and physical victimization are both uniquely related to alcohol and other substance use (e.g., Kilpatrick et al., 2000; Taylor & Kliewer, 2006; Thompson et al., 2019). Although several studies have found that only witnessing violence was related to subsequent changes in alcohol use when accounting for witnessing and victimization (Goldstick et al., 2019; Mrug et al., 2009; Pinchevsky, Wright, et al., 2013), these studies all focused on urban samples. The present findings support the unique
influence of witnessing community violence and physical victimization on patterns of adolescents’ alcohol use in rural settings while controlling for other stressful life events.

The unexpected findings for environmental stressors and peer provocation have several potential explanations. First, the reversal of the direction of findings after controlling for other exposures (i.e., from greater odds of alcohol use to greater odds of abstinence) suggests that shared variance between environmental stressors and peer provocation and the other exposure variables accounts for the results of the individual models. The peer provocation subscale used in this study captures being teased or picked on by other students, and the environmental stress scale captures more severe exclusion and perceived danger from one’s peers (e.g., afraid someone wants to fight you, scared someone has a gun). However, several theories posit that adolescents learn to engage in substance use through their peers (Gifford-Smith et al., 2005; Oetting & Beauvis, 1987). It is possible that adolescents who experienced higher levels of peer provocation and environmental stressors had greater odds of abstaining from use because they had a lower social status or were not engaging with alcohol-using peers. This is supported by prior research showing that adolescent popularity is associated with higher levels and increases in their alcohol use (Choukas-Bradley et al., 2015; Gommans et al., 2016) and avoiding social relationships is associated with less frequent alcohol use (Niño et al., 2016).

The final goal of this aim was to examine whether exposure to stressors would relate to adolescents’ alcohol use patterns while controlling for peer pressure for substance use. Adolescents often learn favorable attitudes toward substance use through their peer groups and engage in similar behavior as their peers (Gifford-Smith et al., 2009; Oetting & Beauvis, 1987). Peers’ behavior, including their substance use and pressure to use substances, is a robust predictor of adolescent substance use (Farrell et al., 2000; Jackson et al., 2014; Cambron et al.,
This aim therefore examined whether the relation between violence exposure and class membership remained significant after controlling for the powerful influence of peers. The results supported the hypothesis that witnessing violence and physical victimization significantly related to alcohol use class membership even after controlling for nonviolent life stressors and peer pressure for substance use. As hypothesized, peer pressure for substance use showed large, significant relations with membership in higher severity alcohol classes use relative to lower severity classes. The exposure to community violence variables remained significant predictors of alcohol use versus abstinence, indicating that they accounted for unique variance in adolescents’ patterns of alcohol use that was not explained by peer pressure. However, in most cases, witnessing violence and physical victimization no longer significantly differentiated between membership in classes characterized by similar severities (e.g., High WBLD vs Mod WBLD) after accounting for peer pressure to use substances. These results are similar to prior findings that violence exposure was uniquely related to alcohol use after controlling for peer risk factors (e.g., Bossarte & Swahn, 2008; Pinchevsky, Wright, et al., 2013; Zimmerman & Kushner, 2017). Although peer substance use is a robust risk factor for adolescent alcohol use, witnessing violence and physical victimization remained uniquely related to rural adolescents’ patterns of alcohol use.

Overall, the findings of this aim indicate that CVE via witnessing and physical victimization are each uniquely related to early adolescents’ alcohol use. These findings also support the unique association of nonviolent stressful life events. In accordance with prior research within urban settings (Thompson et al., 2019), this suggests that researchers aiming to examine associations of CVE with adolescents’ outcomes should control for nonviolent stressful life events to parse out shared variance with these environmental stressors and identify the
unique relations of exposure to community violence. Additionally, these findings indicate that exposure to stressors and peer pressure to use substances uniquely relate to adolescents’ severity of alcohol use. The order in which these mechanisms act may be a question for future research. For example, adolescents may begin using substances to cope and then self-select into peer groups that also use alcohol. Alternatively, adolescents may initiate alcohol with their peers and then begin using it to cope. Different pathways may suggest different mechanisms and key targets of intervention, so future research should aim to examine how these factors influence early adolescent initiation and progression of alcohol use over time.

**Exposure to Community Violence by Sex**

Finally, I examined whether associations between exposure to witnessing violence and physical victimization and class membership differed as a function of sex. Past studies found that among adolescents exposed to violence, female adolescents were more likely than male adolescents to initiate alcohol use before age 14 (Ramos-Olazagasti et al. (2017), and only female adolescents, and not male adolescents, showed an increase in their alcohol use as a result of witnessing violence (Pinchevsky, Wright, et al., 2013). Based on these prior studies, I hypothesized that exposure to violence would be more strongly associated with severity of alcohol use for female than for male adolescents. The findings partially supported this hypothesis. Sex significantly moderated the relation between physical victimization and class membership, but not the relation between witnessing violence and class membership. At low levels of physical victimization, female adolescents were more likely than male adolescents to remain abstinent from alcohol use and less likely to be in classes that had initiated alcohol use (i.e., *Initiators* WB) and engaged in moderately frequent alcohol use (i.e., *Moderate* WB). In contrast, at high levels of physical victimization, female adolescents were less likely than male
adolescents to remain abstinent from alcohol use and more likely to be in these classes (i.e., *Initiators WB, Moderate WB*). These findings suggest that physical victimization more strongly relates to initiation of alcohol use among female adolescents than male adolescents. However, it does not necessarily relate to female adolescents engaging in the most severe patterns of use. This is consistent with the findings of Ramos-Olzagasti et al., (2017) that exposure to violence predicted initiation of alcohol use only among female adolescents.

These findings may be explained by sex differences in coping styles. Using alcohol to mitigate distress is an emotion-focused or avoidant coping style (Lazarus & Folkman, 1984; Wills & Filer, 1996). Some evidence suggests that female youth are more likely to engage in emotion-focused coping than male youth (Kort-Butler, 2009; Wingo et al., 2015). The present results suggest that female and male adolescents may cope differently with violent physical victimization, such that female adolescents are more likely to begin using alcohol to cope. However, these associations have rarely been studied and the findings of the present study cannot be interpreted as causal. Additional research is needed to draw clearer conclusions on sex or gender differences in exposure to violence and alcohol use, and whether this relation may be explained by coping strategies.

**Limitations**

Although the current study addressed key gaps in the literature, there are several limitations that should be considered. The study relied on adolescent self-report, which may be biased, particularly because alcohol use is a socially undesirable behavior for adolescents. However, there is evidence that adolescents provide more accurate reports of their behavior than their caregivers, who tend to underreport their adolescents’ rates of substance use (for a review, see Piehler et al., 2019). Another limitation is the use of data from a school-based sample.
Because adolescents who are frequently absent from school tend to engage in more substance use than students who are not absent (Henry & Thornberry, 2010), the school-based sample may have resulted in lower estimates of alcohol consumption. In addition, the use of cross-sectional data prevented making strong inferences about the directionality of the relation between violence exposure and alcohol consumption. However, a cross-sectional design was appropriate to describe heterogeneity in patterns of adolescent alcohol use, which was the primary aim of the study. Because the sample focused on rural, low-income students, the results may not generalize to youth living in different settings. Moreover, because the data were collected over 20 years ago, the results may not generalize to current adolescents. During the mid- to late-1990’s, 52 to 55% of youth in eighth grade reported drinking alcohol in their lifetime (Johnston et al., 2021). This rate declined to about 26% of eighth graders in 2020. Current adolescents might be less likely to consume alcohol before or during middle school than those in the present sample. However, research using samples from the 1990’s (Wagner & Anthony, 2002) and more recent data (Forman-Hoffman et al., 2017) both suggest that the risk for alcohol initiation rises drastically during early adolescence.

As in any study involving secondary analysis, this study was limited to the measures used in the project that provided the data. One limitation is the time frame covered by the alcohol use variables. The study assessed lifetime alcohol use and frequency of use over the past 30 days. It thus remains unknown whether the prior month was the first time that participants drank alcohol, and how often the participants consumed alcohol in a typical month. However, this measurement approach is used often in studies of substance use, including the Monitoring the Future survey (Johnston et al., 2021). Another limitation is the absence of indicators of alcohol use that have been used in prior LCA studies, including quantity of alcohol consumed and consequences of
drinking alcohol (e.g., Dauber et al., 2009; Donovan & Chung, 2015; Reboussin et al., 2006). This limits making clear comparisons across studies. In the present study, participants’ reports of getting drunk was at best a rough indicator of the quantity of alcohol consumed. Although some prior studies have included consequences of alcohol use as latent class indicators, this was not consistent with this study’s focus on patterns of alcohol use.

Another important consideration is the relevance of the measure of nonviolent stressors for the current sample. Because the measure was created based on the reported experiences of African American adolescents attending urban middle schools (Farrell et al., 1998), it could be missing potential stressors for the diverse sample of adolescents living in a rural area in this study. Moreover, non-White adolescents experience unique stressors that were not assessed in the current study, including experiences of racism, acculturation, and acculturative stress (e.g., Oshri et al., 2014; Pittman et al., 2019; Unger et al., 2016; Wahl & Eitle, 2010; Zamboanga et al., 2009). Gender and sexual orientation minoritized youth also experience higher rates of social stress due to discrimination, bullying, and peer victimization, which is related to greater risk for substance use (Day et al., 2017; Goldbach et al., 2014; Lowry et al., 2017; Reisner et al., 2015). Thus, the present study did not fully account for the variety of stressful life experiences that may have been experienced by the adolescents in the sample and potentially related to their alcohol use.

Conclusions

This study addressed gaps in the literature regarding the heterogeneity in alcohol use among middle school students, and the extent to which exposure to community violence and nonviolent stressors relates to adolescents’ patterns of alcohol use. The findings have implications for research into early adolescent alcohol use. Prior reviews of studies using LCA to
examine substance use have called for the use of categorical rather than binary indicators (Tomczyk et al., 2015). The findings of the present latent class analyses highlight the benefits of using categorical variables that capture variability in individuals’ frequency of alcohol use. When the best categories for a given variable are unclear, the progressive elaboration strategy (Donovan & Chung, 2015) may be a useful procedure to guide the researcher in selecting the categories that result in the best within-class homogeneity and across-class separation. Future latent class analyses should continue to use more than two frequency categories rather than binary indicators of substance use. The present findings also highlight the importance of considering adolescents’ use of different types of alcohol (e.g., wine, beer, liquor). In particular, liquor co-occurred with greater severity in adolescents’ overall alcohol use. To continue exploring these relations, future studies interested in alcohol use outcomes should assess various types of alcohol (e.g., liquor, wine, beer) that vary in alcohol content rather than a single item assessing overall alcohol use.

This study identified subgroups of adolescents consuming alcohol at varying levels of severity. This suggests that LCA could be a useful method for identifying which adolescents would or would not benefit from substance use prevention programs or interventions (see Lanza & Rhoades, 2013). Moreover, whereas some patterns reflect more normative alcohol use (i.e., initiation), others reflected severe use (i.e., current highly frequent use and drunkenness). LCA might thus be useful for identifying adolescents’ level of prevention or intervention needs. The use of LCA to identify patterns of alcohol use also provided a new perspective on how CVE relates to adolescents’ overall patterns of alcohol use. Whereas variable-centered approaches focus on relations between mean levels of violence exposure and alcohol use, the current study examined how adolescents’ patterns of alcohol use behaviors varied based on their frequency of
CVE. Although interpretation of results can be challenging, LCA is appropriate when the variable is heterogenous in the population, such as substance use. Future studies examining risk and protective factors for alcohol use should consider using LCA to better describe variability in this behavior.

The findings of the present study also have implications for prevention and intervention efforts targeting early adolescent alcohol use. In this study, the rate of alcohol use initiation more than doubled between sixth and eighth grade students. Eighth graders were also at increased risk for engaging in patterns of alcohol use that included consuming high-content alcoholic beverages and getting drunk. These findings highlight the need for interventions early in middle school aiming to delay initiation of alcohol use and slow the progression of use among those who have already initiated use. In the current sample, adolescents who engaged in the rarest and most severe patterns of alcohol use differed from their peers based on drinking liquor and getting drunk. The findings that drinking liquor and drunkenness tended to co-occur in this sample, and that drunkenness is associated with a variety of high-risk behaviors, suggests that middle school students who report lifetime consumption of liquor may be at greater risk of engaging in frequent and problematic alcohol use than their peers. Assessing liquor use may be a useful mechanism of identifying adolescents in need of targeted alcohol use interventions. An additional consideration is that adolescents may be unaware of differences in alcohol content across beverages (e.g., beer versus liquor), such that adolescents who try liquor are initially unaware that it will lead to drunkenness even when consumed in low quantities. Preventive interventions should consider including lessons on differences in alcohol content between beverages to ensure that youth understand the risk of consuming high-content liquor, in addition to consequences of consuming...
alcoholic beverages that may be perceived as “safer,” such as wine or wine coolers and beer in high quantities.

Finally, the findings of this study suggest that adolescents who are exposed to community violence are at increased risk of engaging in alcohol use, including elevated risk of engaging in higher severity patterns of use relative to their peers. This suggests the need for universal school- or community-based alcohol use prevention programs for early adolescents living in communities with high rates of violence. It may be particularly helpful for prevention programs to introduce adaptive strategies for coping with distress. Additionally, school- or community-level interventions which introduce policies aiming to reduce adolescent’s victimization experiences may also protect against alcohol use. Although such interventions often target youth living in urban settings, the current study provides evidence that witnessing violence and physical victimization are also key risk factors for alcohol use among adolescents living in rural settings. Future research should continue to examine risk and protective factors for alcohol use among youth living in rural settings. Longitudinal research is needed to examine relations between exposure to stressors and changing patterns of alcohol use among early adolescents, in addition to examining mechanisms that explain these relations.
References


Zamboanga, B. L., Schwartz, S. J., Jarvis, L. H., & Van Tyne, K. (2009). Acculturation and substance use among Hispanic early adolescents: investigating the mediating roles of

Vita

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### Appendix

**Table A-1**

*Model Fit Indices for the Five-Class Model of Alcohol Use with Progressive Cut Points*

<table>
<thead>
<tr>
<th>Model</th>
<th>Description of cut points</th>
<th>LL</th>
<th>npar</th>
<th>LR $\chi^2$</th>
<th>df</th>
<th>$p$</th>
<th>AIC</th>
<th>BIC</th>
<th>SABIC</th>
<th>CAIC</th>
<th>AWE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model Comparisons for Wine Cut Points</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25414.10</td>
<td>25700.92</td>
<td>25561.10</td>
<td>25744.92</td>
<td>26207.74</td>
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<td>Comparison</td>
<td>wine, beer, liquor, drunk trichotomous</td>
<td>-12663.05</td>
<td>44</td>
<td>84.65</td>
<td>54</td>
<td>&lt; .001</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Wine A</td>
<td>wine A; beer, liquor, drunk trichotomous</td>
<td>-13592.97</td>
<td>49</td>
<td>116.25</td>
<td>58</td>
<td>&lt; .001</td>
<td>27283.94</td>
<td>27603.36</td>
<td>27447.65</td>
<td>27652.36</td>
<td>28167.77</td>
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<td>Wine B</td>
<td>wine B; beer, liquor, drunk trichotomous</td>
<td>-13439.53</td>
<td>49</td>
<td>116.05</td>
<td>58</td>
<td>&lt; .001</td>
<td>26977.05</td>
<td>27296.46</td>
<td>27140.76</td>
<td>27345.46</td>
<td>27860.87</td>
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<td><strong>Model Comparisons for Beer Cut Points</strong></td>
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<td>27296.46</td>
<td>27140.76</td>
<td>27345.46</td>
<td>27860.87</td>
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<tr>
<td>Comparison</td>
<td>wine B; beer, liquor, drunk trichotomous</td>
<td>-13439.53</td>
<td>49</td>
<td>116.05</td>
<td>58</td>
<td>&lt; .001</td>
<td>26977.05</td>
<td>27296.46</td>
<td>27140.76</td>
<td>27345.46</td>
<td>27860.87</td>
</tr>
<tr>
<td>Beer A</td>
<td>wine B; beer A; liquor &amp; drunk trichotomous</td>
<td>-14214.84</td>
<td>54</td>
<td>212.33</td>
<td>89</td>
<td>&lt; .001</td>
<td>28537.68</td>
<td>28889.69</td>
<td>28718.09</td>
<td>28943.69</td>
<td>29511.69</td>
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<tr>
<td>Beer B</td>
<td>wine B; beer B; liquor &amp; drunk trichotomous</td>
<td>-13972.27</td>
<td>54</td>
<td>226.83</td>
<td>89</td>
<td>&lt; .001</td>
<td>28052.55</td>
<td>28404.55</td>
<td>28232.96</td>
<td>28458.55</td>
<td>29026.56</td>
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<td><strong>Model Comparisons for Liquor Cut Points</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>28404.55</td>
<td>28232.96</td>
<td>28458.55</td>
<td>29026.56</td>
<td></td>
</tr>
<tr>
<td>Comparison</td>
<td>wine B; beer B; liquor &amp; drunk trichotomous</td>
<td>-13972.27</td>
<td>54</td>
<td>226.83</td>
<td>89</td>
<td>&lt; .001</td>
<td>28052.55</td>
<td>28404.55</td>
<td>28232.96</td>
<td>28458.55</td>
<td>29026.56</td>
</tr>
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<td>Liquor A</td>
<td>wine B; beer B; liquor A; drunk trichotomous</td>
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<td>29274.08</td>
<td>29520.56</td>
<td>30141.16</td>
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<td>Liquor B</td>
<td>wine B; beer B; liquor B; drunk trichotomous</td>
<td>-14308.81</td>
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<td>256.44</td>
<td>132</td>
<td>&lt; .001</td>
<td>28735.63</td>
<td>29120.22</td>
<td>28932.74</td>
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<td>29799.82</td>
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<td>28458.55</td>
<td>29026.56</td>
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<tr>
<td>Comparison</td>
<td>wine B; beer B; liquor &amp; drunk trichotomous</td>
<td>-13972.27</td>
<td>54</td>
<td>226.83</td>
<td>89</td>
<td>&lt; .001</td>
<td>28052.55</td>
<td>28404.55</td>
<td>28232.96</td>
<td>28458.55</td>
<td>29026.56</td>
</tr>
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<td>Drunk A</td>
<td>wine B; beer B; liquor trichotomous; drunk A</td>
<td>-14422.38</td>
<td>59</td>
<td>293.14</td>
<td>132</td>
<td>&lt; .001</td>
<td>28962.77</td>
<td>29347.37</td>
<td>29159.88</td>
<td>29406.36</td>
<td>30026.96</td>
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### Table 1: Description of cut points

<table>
<thead>
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<th>Model</th>
<th>Description of cut points</th>
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<th>npar</th>
<th>LR χ²</th>
<th>df</th>
<th>p</th>
<th>AIC</th>
<th>BIC</th>
<th>SABIC</th>
<th>CAIC</th>
<th>AWE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drunk B</td>
<td>wine B; beer B; liquor trichotomous; drunk B</td>
<td>-14323.57</td>
<td>59</td>
<td>266.09</td>
<td>132</td>
<td>&lt; .001</td>
<td>28765.15</td>
<td>29149.74</td>
<td>28962.26</td>
<td>29208.74</td>
<td>29829.34</td>
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</tbody>
</table>

*Note.* Values in table reflect a sequential process whereby cut points were established for each indicator and carried forward into subsequent models to test the remaining indicators. Comparison models were the best fitting model from the prior step of the sequential process. Each comparison model was compared to models for each indicator with cut point option A and B: A = cut points "never," "initiated, 0 times," "1-2 times", ">2 times"; B = cut points "never," "initiated, 0 times," "1-5 times", ">5 times". Bolded values indicate the model at each stage that was selected and moved forward into subsequent models.

LL = maximum likelihood value obtained for each model, Npar = number of free parameters in the model. LR χ² = likelihood ratio chi-square goodness of fit statistic with degrees of freedom and p-value, AIC = Akaike’s information criterion, BIC = Bayesian information criterion, SABIC = sample-size adjusted BIC, CAIC = consistent Akaike’s information criterion, AWE = average weight of evidence criterion.
Table A-2

Model Comparisons for Stepwise DIF Testing for Sex with the Five-Class Model of Alcohol Use

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>LL</th>
<th>Npar</th>
<th>SCF</th>
<th>Comparison</th>
<th>CF</th>
<th>LRTS</th>
<th>df</th>
<th>p</th>
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<td><strong>Step 1: Comparison of MIMIC models with and without DIF</strong></td>
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<tr>
<td>M1.0</td>
<td>No DIF</td>
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<td>58</td>
<td>1.06</td>
<td>M1.0 vs. M1.1</td>
<td>0.86</td>
<td>70.92</td>
<td>20</td>
<td>0.000</td>
</tr>
<tr>
<td>M1.1</td>
<td>All DIF</td>
<td>-13711.99</td>
<td>78</td>
<td>1.01</td>
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<td></td>
</tr>
<tr>
<td></td>
<td><strong>Step 2: Testing for nonuniform DIF</strong></td>
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<tr>
<td>M2.0.1</td>
<td>Wine: No DIF</td>
<td>-9332.18</td>
<td>23</td>
<td>1.00</td>
<td>M2.0.1 vs. M2.1.1</td>
<td>0.37</td>
<td>80.70</td>
<td>5</td>
<td>0.000</td>
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<td>M2.1.1</td>
<td>Wine: Nonuniform DIF</td>
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<td>0.89</td>
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<td>M2.0.2</td>
<td>Beer: No DIF</td>
<td>-8078.23</td>
<td>23</td>
<td>1.00</td>
<td>M2.0.2 vs. M2.1.2</td>
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<td>55.67</td>
<td>5</td>
<td>0.000</td>
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<td>M2.1.2</td>
<td>Beer: Nonuniform DIF</td>
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<td>0.86</td>
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<td>M2.0.3</td>
<td>Liquor: No DIF</td>
<td>-7875.30</td>
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<td>1.00</td>
<td>M2.0.3 vs. M2.1.3</td>
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<td>18.70</td>
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<td>Liquor: Nonuniform DIF</td>
<td>-7871.55</td>
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<td>0.87</td>
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<td>M2.0.4</td>
<td>Drunk: No DIF</td>
<td>-7974.45</td>
<td>18</td>
<td>1.00</td>
<td>M2.0.4 vs. M2.1.4</td>
<td>0.57</td>
<td>34.49</td>
<td>5</td>
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<tr>
<td>M2.1.4</td>
<td>Drunk: Nonuniform DIF</td>
<td>-7964.63</td>
<td>23</td>
<td>0.91</td>
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<td></td>
<td><strong>Step 3: Comparison of MIMIC models with nonuniform DIF to models with and without uniform DIF</strong></td>
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<tr>
<td>M3.0</td>
<td>Nonuniform DIF: wine, beer, liquor, drunk</td>
<td>-13711.99</td>
<td>78</td>
<td>1.01</td>
<td>M1.0 vs. M3.0</td>
<td>0.86</td>
<td>70.92</td>
<td>20</td>
<td>0.000</td>
</tr>
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<td></td>
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<td>M1.1 vs. M3.0</td>
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<td><strong>Step 4: Testing MIMIC models for uniform DIF</strong></td>
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<tr>
<td>M4.1</td>
<td>All items nonuniform except wine</td>
<td>-13714.71</td>
<td>74</td>
<td>1.03</td>
<td>M4.1 vs. M3.0</td>
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<td>10.08</td>
<td>4</td>
<td>0.039</td>
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<td>M4.2</td>
<td>All items nonuniform except beer</td>
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<td>74</td>
<td>1.00</td>
<td>M4.2 vs. M3.0</td>
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<td>1.01</td>
<td>M4.3 vs. M3.0</td>
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<td>All items nonuniform except drunk</td>
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<td>M4.4 vs. M3.0</td>
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<td>M5.0</td>
<td>Uniform DIF for beer and liquor; Nonuniform DIF for drunk and wine</td>
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<td>1.00</td>
<td>M5.0 vs. M3.0</td>
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<td>Uniform DIF for wine, beer, liquor; Nonuniform DIF for drunk</td>
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<td>0.527</td>
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</table>

*Note. DIF = differential item functioning, LL = maximum log likelihood, Npar = number of free parameters in the model, SCF = scaling factor, df = degrees of freedom, CF = correction factor, LRTS = likelihood ratio test statistic, MIMIC = multiple indicator multiple cause model*
Table A-3

Model Comparisons for Stepwise DIF Testing for Grade with the Five-Class Model of Alcohol Use

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>LL</th>
<th>Npar</th>
<th>SCF</th>
<th>Comparison</th>
<th>CF</th>
<th>LRTS</th>
<th>df</th>
<th>p</th>
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<td>Step 1: Comparison of MIMIC models with and without DIF</td>
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<tr>
<td>M1.0</td>
<td>No DIF</td>
<td>-13796.45</td>
<td>62.00</td>
<td>1.07</td>
<td>M1.0 vs. M1.1</td>
<td>1.33</td>
<td>84.91</td>
<td>40</td>
<td>0.000</td>
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<td>M1.1</td>
<td>All DIF</td>
<td>-13739.99</td>
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<td></td>
<td>Step 2: Testing for nonuniform DIF</td>
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<td></td>
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<td>M2.0.1</td>
<td>Wine: No DIF</td>
<td>-9332.56</td>
<td>27.00</td>
<td>1.00</td>
<td>M2.0.1 vs. M2.1.1</td>
<td>0.78</td>
<td>15.29</td>
<td>10</td>
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<td>Wine: Nonuniform DIF</td>
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<td>0.94</td>
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<td>Beer: No DIF</td>
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<td>1.01</td>
<td>M2.0.2 vs. M2.1.2</td>
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<td>0.91</td>
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<td>Liquor: No DIF</td>
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<td>1.00</td>
<td>M2.0.3 vs. M2.1.3</td>
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</tr>
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<td>M2.1.3</td>
<td>Liquor: Nonuniform DIF</td>
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<td>0.87</td>
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<td>Drunk: No DIF</td>
<td>-7952.73</td>
<td>22.00</td>
<td>1.00</td>
<td>M2.0.4 vs. M2.1.4</td>
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<tr>
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<td>0.95</td>
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<td>Step 3: Comparison of MIMIC models with nonuniform DIF to models with and without uniform DIF</td>
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<tr>
<td>M3.0</td>
<td>No DIF: wine; Nonuniform DIF: beer, liquor, drunk</td>
<td>-13747.76</td>
<td>92.00</td>
<td>1.11</td>
<td>M1.0 vs. M3.0</td>
<td>1.19</td>
<td>81.96</td>
<td>30</td>
<td>0.000</td>
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<tr>
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<td>Nonuniform DIF: beer, liquor, drunk</td>
<td></td>
<td></td>
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<td>M1.1 vs. M3.0</td>
<td>1.76</td>
<td>8.85</td>
<td>10</td>
<td>0.546</td>
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<td>Step 4: Testing MIMIC models for uniform DIF</td>
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<tr>
<td>M4.1</td>
<td>All items nonuniform except beer</td>
<td>-13757.42</td>
<td>84.00</td>
<td>1.06</td>
<td>M4.1 vs. M3.0</td>
<td>1.61</td>
<td>11.98</td>
<td>8</td>
<td>0.152</td>
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<tr>
<td>M4.2</td>
<td>All items nonuniform except liquor</td>
<td>-13756.06</td>
<td>84.00</td>
<td>1.10</td>
<td>M4.2 vs. M3.0</td>
<td>1.22</td>
<td>13.60</td>
<td>8</td>
<td>0.093</td>
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<td>M4.3</td>
<td>All items nonuniform except drunk</td>
<td>-13756.44</td>
<td>84.00</td>
<td>1.04</td>
<td>M4.3 vs. M3.0</td>
<td>1.86</td>
<td>9.35</td>
<td>8</td>
<td>0.313</td>
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<td>Step 5: Comparing MIMIC models with uniform and nonuniform DIF to model with nonuniform DIF only</td>
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<tr>
<td>M5.0</td>
<td>No DIF for wine; Uniform DIF for beer, liquor, drunk</td>
<td>-13776.95</td>
<td>68.00</td>
<td>1.04</td>
<td>M5.0 vs. M3.0</td>
<td>1.30</td>
<td>44.78</td>
<td>24</td>
<td>0.006</td>
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<tr>
<td>M5.1</td>
<td>No DIF for wine; Uniform DIF for beer and drunk; Nonuniform DIF for liquor</td>
<td>-13767.51</td>
<td>76.00</td>
<td>1.03</td>
<td>M5.1 vs. M3.0</td>
<td>1.47</td>
<td>26.83</td>
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<tr>
<td>M5.2</td>
<td>No DIF for wine; Uniform DIF for drunk; Nonuniform DIF for liquor and beer</td>
<td>-13756.44</td>
<td>84.00</td>
<td>1.04</td>
<td>M5.2 vs. M3.0</td>
<td>1.86</td>
<td>9.35</td>
<td>8</td>
<td>0.313</td>
</tr>
</tbody>
</table>

Note. DIF = differential item functioning, LL = maximum log likelihood, Npar = number of free parameters in the model, SCF = scaling factor, df = degrees of freedom, CF = correction factor, LRTS = likelihood ratio test statistic, MIMIC = multiple indicator multiple cause model
Table A-4

*Model Comparisons for Stepwise DIF Testing for Racial-Ethnic Group with the Five-Class Model of Alcohol Use*

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>LL</th>
<th>Npar</th>
<th>SCF</th>
<th>Comparison</th>
<th>CF</th>
<th>LRTS</th>
<th>df</th>
<th>p</th>
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<td></td>
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<td>Step 1: Comparison of MIMIC models with and without DIF</td>
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<td>M1.0</td>
<td>No DIF</td>
<td>-13479.98</td>
<td>66.00</td>
<td>1.07</td>
<td>M1.0 vs M1.1</td>
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<td>63.49</td>
<td>60</td>
<td>0.354</td>
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<tr>
<td>M1.1</td>
<td>All DIF</td>
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<td>126.00</td>
<td>1.10</td>
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<td></td>
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</tr>
</tbody>
</table>

*Note.* DIF = differential item functioning, LL = maximum log likelihood, Npar = number of free parameters in the model, SCF = scaling factor, df = degrees of freedom, CF = correction factor, LRTS = likelihood ratio test statistic, MIMIC = multiple indicator multiple cause model