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The Community Substance Use Environment: The Development and Predictive Ability of a Multi-method and Multiple-reporter Measure

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Abstract

This study tested the feasibility and utility of developing a multiple-method and multiple-reporter measure that describes the community substance use environment. Data on community-level norms and availability of substances were reported by 5,261 students and 181 prevention-focused community leaders involved in the 28 PROSPER Project communities between 2002–2005. Additionally, locations of alcohol and tobacco outlets were geocoded. Initially, these four subscales were aggregated to measure the community substance use environment. Analyses demonstrated this measure was associated with community rates of adolescent reported cigarette use, but it was not associated with community rates of adolescent reported alcohol use. Further analyses tested the relative strength of the four different subscales in predicting rates of student use. Implications of these results for the field of community-based prevention are discussed, as well as limitations and future directions.

Keywords

Adolescence; substance use; community context; geographic information systems; prevention; risk

Risk factors at multiple levels including the individual youth, peers, family, and community are believed to influence substance abuse outcomes (Hawkins, Catalano, & Miller, 1992). Despite attention to the importance of the community context (Clinton, 1996; Gore, 2003; McLaughlin, 2000; Whitford, 2005) and increased funding for community-level prevention efforts (e.g., Drug Free Communities, Weed & Seed, and the Strategic Prevention Framework State Incentive Grants), there has been little comprehensive, empirical assessment of the *community-level* factors that are associated with adolescent substance use. This paper has responded to this deficit by: (a) examining the *community substance use environment* as assessed by the norms and availability of substances at the community level, and (b) examining how assessment of the community substance use environment predicts community rates of adolescent substance use.

Conceptualization of Community

Various definitions of community are used in research on human development and often words such as community and neighborhood are interchanged, which can lead to inconsistent results (Leventhal & Brooks-Gunn, 2000). Indeed, community or neighborhood can be defined by researchers as census blocks or tracts (Cook, Herman, Phillips, & Settersten, 2002; Peterson, Krivo, & Harris, 2000; Duncan, Duncan, & Strycker, 2002), school districts (Dent & Biglan, 2004), a specific school catchment area (Ennett, Flewelling, Lindrooth & Norton, 1997), or zip codes (Gruenewald, Johnson, & Treno, 2002). Researchers sometimes incorporate landmarks and other indicators to operationally define communities or neighborhoods (Sampson, Raudenbush, & Earls, 1997; Chuang, Cubbin, Ahn, & Winkleby, 2005). Sometimes the definition of community or neighborhood is left to the interpretation of research participants (Cook et al., 2002, 1997; Ennett et al., 1997). Lastly, the word “community” can represent a group of individuals that has a shared characteristic, interest, or common goal that is not at all geographically determined (Blanchard, 2008).

In the present study, *community* is conceptualized as the physical structures, behaviors, norms and culture, and demographic characteristics of the people and places that are located within unified school district boundaries, as school boundaries as an organizational structure are likely to be meaningful geographic divisions for adolescents and their parents (Ennett et al., 1997; Resnick, Ireland, & Borowsky, 2004). Here, the school district rather than the school is used as the unit of analysis, because the majority (86%) of communities in the current sample have one middle school and 100% of the communities have one high school, and the word *community* rather than neighborhood is used because of the broad geographic area encompassed within these rural and small town district boundaries.

The Community Substance Use Environment

The current study has utilized community-level analyses to focus on one potentially important aspect in predicting early adolescent substance use, the community substance use environment. Here, the community substance use environment is measured by a composite of observable indicators that assess the norms and availability of substances. These constructs were selected for two reasons. First, norms and availability of substances are two of the strongest individual-level predictors of early adolescent substance use. Second, there are policy and/or program innovations that could be made in communities that may change the norms and availability of substances and thus measures of the community context are necessary to assess such community-level changes. The following section briefly reviews how these constructs have previously been measured.

Norms of adolescent substance use

There is considerable research that norms are an important predictor or risk of use (Beyers, Toumbourou, Catalano, Arthur, & Hawkins, 2004; Botvin, Griffin, Diaz, & Ifill-Williams, 2001; Elek, Miller-Day, & Hect, 2006; Hansen & Graham, 1991; Lillehoj et al., 2005). However, most of this norms research has been conducted at the individual level, relating individual perception of norms to individual report of use, which is subject to a method and reporter bias (Campbell & Fiske, 1959; Dodge, 2008). This current study has focused on the association between norms and use at the level of the community and has tested to see if the positive association between norms and use is found when norms and use are assessed by different reporters.

Community-wide norms regarding adolescent substance use are collectively defined rules of behavior. As such, community norms have been challenging to measure and have been

assessed in many different ways. Assessment techniques have included surveying adult community members' own norms (Beebe, Harrison, Sharma & Hedger, 2001), surveying school administrators and/or teachers about the policies and consequences of substance use by staff and students (Kumar, O'Malley & Johnston, 2005; Moore et al., 2001), assessing adolescent perceptions of community norms (Arthur et al., 2002; Beyers et al., 2004), operationalizing norms as an aggregate measure of student use (Allison et al., 1999) or using an aggregate measure of student-reported peer norms (Ennett et al., 1997). In addition, some researchers have investigated adolescent report of exposure to pro-use advertising (Atkin, Hocking, & Block, 1984; Martino et al., 2006) as advertising may be an indication of norms.

Availability of substances

The availability of substances in the community may influence norms for use and simply provide the opportunity to use (Wagenaar & Perry, 1994). Previous individual-level research shows a consistent positive association between the availability of substances and adolescent substance use (Arthur et al., 2002; Ennett et al., 1997; Johnston, O'Malley, Terry-McElrath, 2004). However, this research is also affected by a method and reporter bias.

Community-level availability of substances has been assessed in many different ways including (a) adult perceptions of the density of alcohol outlets (Kuntsche & Kuendig, 2005); (b) parent-reported neighborhood drug activity (Ennett et al., 1997); (c) observational reports of the presence of drugs (Allison et al., 1999; Sampson & Raudenbush, 1999); (d) using geographic information systems to measure the density of alcohol and/or tobacco outlets within a given area (Freisthler, Midanik, & Gruenewald, 2004; Reid, Peterson, Lowe, & Hughey, 2005; Scribner, Mackinnon, & Dwyer, 1995); (e) measuring the rate of illegal sales to minors (Dent & Biglan, 2004; Dent et al., 2005); and with (f) general questions to adults about the availability of substances to adolescents (Beebe et al., 2001).

Results relating availability to adolescent substance use from the above cited studies are mixed. The association between availability and adolescent use is consistently strong when availability is assessed through adolescent report; students that are using substances know how to access substances. The association has weakened when availability is assessed with an alternative procedure that assesses community-level availability rather than a specific individual's ease of access. The current report has focused on assessing availability and use at the level of community, rather than at the level of the individual.

The Utility of Community-level Analyses

The current study is focused on understanding the environmental predictors of health risk behaviors of adolescent populations, and as such, has used community-level predictors and community-level outcomes in analyses. Using this strategy is important because the design and statistical analysis used in research must fit the conceptual model being tested (Diez-Roux, 1998). Community level factors may explain why certain behaviors persist in certain geographic locations over long periods of time (Shaw & McKay, 1999); hence, it is possible that changing the appropriate community-level characteristics will have a stronger and more sustainable effect in decreasing rates of adolescent substance use compared to changing characteristics of individuals. Further, community-level prevention efforts may be preferable to individual-level efforts in some communities to alter behavior, especially in communities with high levels of population mobility.

Previous assessment of the community risk factors has largely focused on individual perceptions of the community context and has then related individual perceptions of the community context to individual outcomes (Hawkins, Van Horn, & Arthur, 2004; Johnston et al., 2004). Though undoubtedly important, this research based on individual-level

analyses may lead to generalizations about how community-level factors are associated with health outcomes, which is one example of an atomistic fallacy (Diez-Roux, 1998). Individual-level analyses cannot adequately inform the development of interventions that focus on changing community-level factors because it leaves the following question open: “Is it the community context *or* the *perception* of the community context that needs to change in order for rates of adolescent risk behaviors to change?” It could be argued that a change in the community context would relate to a change in the individual perception of the context, which may lead to a change in outcomes; however, such research has not yet been conducted in early adolescent prevention and risk behavior research.

Recently, multi-level research models have been utilized in which community-level factors and individual-level characteristics are considered in the same model to predict individual-level outcomes. These models have been useful for examining the individual in context as they control for necessary community-level factors that might affect on individual-level outcomes. However, conclusions in such models can only be made at the level the variables are measured, which would be the individual-level (Beyers, Bates, Pettit & Dodge, 2003; Moore, Roberts, Todor-Smith, 2001).

The Current Study

This study takes a multi-dimensional approach to assessing the substance use environment in communities. In order to separate shared method and/or rater variance from true score variance, two different raters are used to measure community norms of adolescent substance use and two different techniques are employed to measure community availability of substances. Adolescent substance use norms are assessed by adolescents and by key community leaders involved in prevention activities. Substance availability is assessed by community leader report and by the geographic density of alcohol and tobacco outlets. Three hypotheses are investigated. First, we hypothesize that perceived substance availability and norms reported by key community members, norms reported by adolescents, and the density of alcohol and tobacco outlets will all positively relate to each other, and we will form a composite measure of the community substance use environment. Second, we expect that the community substance use environment measure will be associated with community rates of early adolescent alcohol and cigarette use. Third, given that previous research suggests the strongest associations occur when the same methods and reporters are used, we expect that student reported norms will more strongly predict community rates of adolescent alcohol and cigarette use than will adult reports or GIS measures.

Method

The sample included all 28 school district sites of the PROSPER project (Spoth, Greenberg, Bierman, & Redmond, 2004). PROSPER (PROMoting School-university-community Partnerships to Enhance Resilience) is a randomized trial of a community-level dissemination system for empirically validated substance abuse prevention programs for middle school students and their families in rural and small town school districts in Iowa and Pennsylvania. The dissemination system is organized around partnerships between the Cooperative Extension System [CES] and the public education system; local CES educators catalyze the formation of local prevention teams.

Primary eligibility criteria for communities were: (a) school district enrollment (k-12) between 1,301–5,200 students located in non-metropolitan areas; (b) districts with at least 15% of families eligible for free or reduced cost lunches; (c) districts that were not involved in other university-affiliated youth-prevention research projects; (d) districts that had fewer than 50% of the population employed by or attending a university. The participating

universities' Institutional Review Boards authorized the study before participant recruitment began.

Overall, each community (i.e. school district) in the sample was composed of anywhere from 2–13 (sections or whole) small towns, large towns, townships, and/or unincorporated county areas; in addition to the school district, often these small towns, townships, etc. shared resources such as police, fire, and government. Aggregated census characteristics describe the community sample to have low rates of poverty ($M = 6.8\%$, range 1.9% – 10.7%), a household median income of \$37,082 (range \$28,368 – \$52,488), and be 95.6% white (range 87.8% – 99.0%).

Data for this paper were collected from three different sources: 1) interviews with key community leaders, 2) surveys collected from 8th grade students, and 3) spatial data derived from state government agencies. More specific information about the samples and the measures derived from these samples is described below.

Participants & Procedures

Community leaders—The community leader (CL) sample included 181 individuals that work in the area of youth development and prevention, including local Cooperative Extension, school, mental health, and substance abuse representatives, and parents. All individuals were recruited by local extension educators and school district representatives, and recruitment coincided with the start of the project in the spring of 2002. Overall, an average of 7 individuals in each community participated in the interviews.

Just after community leaders were recruited and before intervention activities began, all community leaders participated in a one-hour computer-assisted face-to-face pretest interview. Participants were compensated with \$20. Respondents ranged in age from 22–62 ($M = 43.2$, $SD = 8.82$), 32% of respondents were male, and 99% are white. All respondents indicated completing a minimum of a high school education or GED, with 92.8% of the sample having obtained a minimum of a college degree. The majority of the sample (84.5%) lived in or near the school district that was recruited for the PROSPER project. This data collection time point occurred three years before students participated in the surveys used in current analyses.

Student sample—The youth sample included a total of 5261 individuals, for an average of 188 students per community (range 84–395). All respondents were in the eighth grade in the PROSPER communities at the time of the survey. Respondents ranged in age from 12.5–16.3 ($M = 14.3$, $SD = 0.43$), 49.6% of the youth participants are male, and 85.3% of the respondents are white or Caucasian, which is representative of mostly rural and small town communities in the mid-west and north-eastern United States. The remaining sample consisted of a mix of racial/ethnic minorities (6.0% Hispanic/Latino, 3.2% African American, and 5.5% Other).

The student sample was recruited from all eighth grade classes during the 2004–2005 school-year in participating community school districts. This was the third year in which the students participated in the survey. A passive parental consent process (approved by both universities' Institutional Review Board committees) was used which allowed parents to decline participation for their student. Surveys were administered by trained teams using a standardized protocol in which students were assured confidentiality and given the opportunity to decline participation, and make-up sessions were conducted in order to assess as many students as possible. Nearly 90% of the eighth grade students participated in the survey.

Geographic information systems (GIS) methods—As described below, two measures were created with GIS. GIS software matched street address locations to a particular latitude and longitude with a comprehensive street-file database (i.e. to *geocode* an address). All address locations were geocoded by a GIS specialist using ArcGIS 9.1 (Environmental Systems Research Institute, 2005); 20% of the geocoded address locations were checked for quality control with online mapping services. In all, 95% of the alcohol retail locations and 88% of the tobacco retail locations were successfully geocoded.

Measures

Community substance use environment—Ten items distributed among four scales were utilized in the creation of the community substance use environment. First, *team perceived norms* (4-items, $\alpha = .80$; Beebe et al., 2001) assessed community leader perceptions of community acceptance of adolescence alcohol and tobacco use. Second, *perceived availability* (2-items, $r = .51$; Beebe et al., 2001) measured community leader perceptions of the availability of alcohol and tobacco to adolescents. Third, *geographic availability* of alcohol and tobacco was assessed by computing the per 10 km density of alcohol and of tobacco retailers (Gruenewald, Ponicki, & Holder, 1993). In Pennsylvania, these data were derived from information provided by the State Department of Revenue and the Liquor Control Board. In Iowa, these data were derived from information provided by the Alcohol Beverages Division. Density scores were created separately for alcohol and tobacco by geocoding the address locations, summing the number of alcohol and tobacco outlets within each district, dividing the total number of alcohol and tobacco outlets by the total number of kilometers of roadway within each district, and then multiplying by 10. Fourth, *student norms* (2-items, $r = .81$; Hansen, 1996) assessed each individual students' perception of how many of their peers drink alcohol and smoke cigarettes. All individual survey responses were aggregated to the community-level, thereby creating a community-mean score to use in analyses.

Adolescent problem behaviors—Measures of self-reported adolescent alcohol and cigarette use were drawn from the National Youth Survey (Elliott, Huizinga, & Menard, 1989). Adolescent alcohol use was measured with the question: "Have you ever had more than just a few sips of alcohol?" Adolescent cigarette use was measured with the question: "Have you ever smoked a cigarette?" Response options were 1 (*yes*) and 0 (*no*). Student responses for each item were aggregated to the community level by taking the community-mean of each item. Descriptive statistics for all variables in the present study are presented in Table 1 and have indicated that 45% of 8th graders have used alcohol ($\rho_1 = .01$) and 32% have smoked at least one cigarette ($\rho_1 = .03$). Though relatively small in magnitude, both Intraclass Correlation estimates (ρ_1) are significant because of the large individual-level sample size.

Results

Hypothesis 1: Positive Associations among Substance Use Environment Measures

The first hypothesis focused on confirming positive associations among the community substance use environment subscales. Bivariate Pearson correlations and their scatterplots (see Table 3) were used to investigate this question. As expected, correlation analyses indicated that the four subscales had small to moderate correlations with each other; two of which surpassed traditional levels of significance. The geographic access measure had the most consistent association with the other three subscales. Scatterplots of the scales indicated that there were two communities (one in each state) in which community leaders reported more accepting adolescent substance use norms than expected given values on adolescent reported norms, and that one community had a lower than expected level on

community leader reported adolescent access given the high value on geographic availability. Without these communities in the model, the association between CL-reported norms and student-reported norms ($r = .49, p < .01$) and the association between geographic availability and CL-reported availability ($r = .56, p < .01$) increased.

Hypothesis 2: The Association between the Community Substance Use Environment and Rates of Adolescent Substance Use

OLS multivariate regression models were employed to test the importance of possible control variables due to the project's design (i.e. state and intervention condition¹). Final models only controlled for state because (a) experimental condition did not have significant main or interaction effects in any of the models and it was evenly distributed across the two states; (b) state may assess an unmeasured confound that could be responsible for significant associations between the context variables and the outcome; (c) preliminary analyses demonstrated mean differences between the two states on the outcomes but inconsistent associations between state and the community context variables.

Results demonstrated that the community substance environment scale was not associated with community rates of adolescent alcohol use, but it was significantly associated with community rates of adolescent cigarette use ($\beta = .36, p < .10$). Investigation of possible influential observations revealed no changes in these results. Communities with high levels on the community substance use environment scale also had high rates of adolescent cigarette use.

Hypothesis 3: Relative Associative Strength of Subscales with Adolescent Rates of Use

OLS regressions were used to assess the relative strength of community factors associated with adolescent use. Out of the four subscales, the only scale that was significantly associated with community rates of adolescent substance use was the student-reported norms scale. Student-reported norms were significantly associated with community rates of adolescent alcohol use ($\beta = .48, p < .05$) and community rates of adolescent cigarette use ($\beta = .92, p < .0001$), and with student-reported norms in the model, the state difference in community rates of use disappeared. Investigation of possible influential observations revealed the model to be a good fit. Investigation of possible overly influential points for the regression models with the three other subscales revealed one consistent change: The beta for community leader perceived norms had a significant association with community rates of adolescent alcohol use (full model: $\beta = .12, p > .10$; adjusted model: $\beta = .30, p < .10$) and was stronger but not significant with cigarette use (full model: $\beta = .12, p > .10$; adjusted model: $\beta = .25, p = .16$) after dropping the most influential observation from both models; this overly influential observation is the same community in both models.

Discussion

This study examined the ability of a multiple-domain and multiple-reporter measure of the community substance use environment to predict community rates of adolescent substance use. The overall measure was significantly associated with only community rates of cigarette use. Further, additional analyses revealed that this association was driven by the student-reported norms measure. Together these findings highlight several methodological and conceptual issues for the field of early adolescent and community prevention research,

¹Because of the relatively small community-level sample size, significance of all regression models was tested with a 2-tailed, $p < .10$. With these parameters, the current study has statistical power of .61 at $p = .10$ to explain about 10% of the variance ($r = .35$) in the dependent variable (Faul & Erdfelder, 1992). Scatterplots and fit statistics will also be inspected to safeguard against generalizing results to the entire sample when they are being driven by a possible outlier.

which speak to the importance of using multiple methods, reporters, and constructs (Leventhal & Brooks-Gunn, 2003; O'Campo, 2003).

The fact that multiple measures of availability and norms were all positively related may indicate that the attitudes, behaviors, and proximity of the people and places within communities together may create an overall community culture. Hence, we posit that these various observable community characteristics come together to form the community substance use environment (Coltman, Devinney, Midgley, & Venaik, 2008). Given that we theorize that the community substance abuse environment is composed of multiple observable indicators, the value and meaning of the community substance abuse environment will vary based on the reporter, method, and specific domain used to compute community-level scores.

It is possible that there are other aspects of the community substance abuse environment not measured here that are more important in predicting early adolescent substance use. Further, what is meaningful to adolescent populations may vary for adolescents living in different settings (e.g. nonmetropolitan vs. urban), and different aspects of the context might be more meaningful at different developmental stages. For instance, it may be more useful to take a random sampling of resident adults to assess their personal beliefs regarding adolescent substance use rather than survey those adults that are expected to be key informants. Another possibility may be that the density of alcohol and tobacco retailers within a one to two mile radius of the middle school would be more important in nonmetropolitan areas because of the organizing force that school is likely to play in these communities. It is also possible that the density effect disappears in nonmetropolitan areas because a certain minimum population density needs to be met for norms to coalesce. It is also possible that the density of alcohol and tobacco retailers is more important for older adolescents; the current study focused on predicting community rates of early adolescent substance use, whereas previous research that linked characteristics of the physical environment to adolescent substance use focused on older adolescents (Dent & Biglan, 2004; Dent et al., 2005). Future ecological research must give adequate attention to these issues. Understanding the culture of various communities, how different aspects of the environment contribute to the culture, and how aspects of the environment associate with adolescent behaviors at different developmental stages is likely to improve the planning, implementation, and effectiveness of community programs and policies related to positive youth development.

Despite the above mentioned possibilities, we felt it prudent to thoroughly examine our null results. Overall, team-member reported norms had a relatively low level of agreement with student-reported norms, and investigating scatterplots and fit statistics revealed one possible outlier. This led us to drop the most influential case in the adult-reported norms regression models which strengthened the association between adult-reported norms and community rates of adolescent alcohol and cigarette use. This finding may indicate that sometimes adults and youth may have different perceptions of the same issue in the same community. If this is truly the case, it would be important to assess the perceptions from both groups in order to appropriately plan and implement community-level interventions, and this should be considered when selecting members of community collaborative prevention boards/activities. For example, if an adult-driven community prevention effort selected a student-norm focused intervention because the adults perceived a high degree of acceptance of adolescent substance use, but in reality youth perceived a relatively low acceptance of substance use, it is likely that the intervention would not be successful, and may even have an iatrogenic effect on students' perceived norms, and consequently student use.

This finding also draws attention to the importance of sample selection. It is possible that the community leaders selected for interviews in the outlying community were for some reason not the best individuals to report on the community substance use environment. These particular individuals fit the same criteria as other community leader participants in the study; however, there may be something else about them (e.g. the length of time they lived in or worked in the community; their own personal attitudes and/or experiences with substances, etc.) that affected the validity of their responses. Great care should be taken when selecting community leader informants for community research. For example, it may be worthwhile to receive recommendations regarding interview and/or prevention team member participants from multiple informants, rather than rely on one single individual. It may also be worthwhile to ask follow-up questions regarding why particular individuals were recommended to participate in order to confirm that the intentions of the project are being met.

The current findings draw attention to the challenge of shared method/reporter variance in community research. This lack of independence is likely to inflate an association (Campbell & Fiske, 1959), and indeed, the only significant subscale predictor of community rates of adolescent alcohol and cigarette use was the subscale that shared method and reporter variance, the aggregated measure of student reported peer norms. Though this finding replicates prior research (Allison et al., 1999; Arthur et al., 2002; Beyers et al., 2004; Botvin et al., 2001; Elek et al., 2006; Ellickson & Bell, 1990; Hansen & Graham, 1991; Hansen, 1996), there is a clear need to more effectively assess the community context. Additionally, research that focuses on individual reports of the context and outcome leads prevention and youth development professionals to focus on individual-level focused prevention efforts. This study focuses attention on measuring these substance use factors at the community-level, as norms and availability are not pure individual-level factors, but are shaped by collectively defined rules of behavior, the surrounding built environment, and interpersonal interactions. This measurement and analysis strategy most appropriately informs community-level intervention and prevention (Diez-Roux, 1998).

Every data collection method has its biases; there are many ways availability, norms, and use can be measured. Biological markers such as saliva, breathalyzers, and hair tests can be used to assess use (Fendrich, Mackesy-Amiti, Johnson, Hubbell, & Wislar, 2005; Tassiopoulos, et al., 2006). A recent research project analyzed sewage to get city estimates of substance use (Cone, 2008) and other research has counted debris (Sampson & Raudenbush, 1999). Fine-tuning the measurement of these (and other) constructs will better inform the development of intervention and/or prevention programs as well as their measurement. Additionally, some alternative measurement methods easily lend themselves to be integrated into ongoing community practices that could be quickly and routinely monitored, which may put governmental leaders in a position of reacting promptly to changes in use patterns before they reach epidemic proportions.

The current findings also draw attention to the complexity of the community context, such that it may be important to consider a multitude of community characteristics simultaneously because of the complex associations among them. Future research should include a larger number of communities and simultaneously investigate multiple community-level risk and protective factors such as socioeconomic status and the school context.

We found significant differences between the two states in rates of adolescent substance use and student perceived norms. This need demonstrates the importance of including a broad cross-section of communities from geographically distinct parts of the country. Laws, policies and procedures may be different in one state or locality versus another, and it is rare

to see random sampling of communities within states. Most frequently ecological research is conducted on community samples that come from dividing one large urban area into several smaller communities or neighborhoods (Chuang et al., 2005; Sampson, Raudenbush, & Earls, 1997). It is possible that some states or even some cities have different policies regarding the sale of alcoholic beverages, the density of advertizing, and the locations of advertizing, which may moderate an association. In the case of single-state or single-city research, the “state effect” could not be tested, and may lead to incorrect interpretation of the findings.

Lastly, the current analyses highlight one specific point regarding the measure of geographic availability. The results show that the geographic measures are good indicators of the community substance use environment, as they had consistently moderate associations with all norm and availability items included in these analyses. Future research that tests for directional and/or bidirectional associations among geographic factors and use may be instrumental in identifying appropriate targets for community-based interventions. For example, it is possible that interventions that target the density of alcohol and tobacco outlets may have an *indirect* association with rates of adolescent use, especially during early adolescence, when youth most frequently gain access to substances from friends or family members, rather than commercial sources (Wagenaar et al, 1993). It is possible that the density of alcohol and tobacco outlets is associated with community norms or expectancy of use, which then affect community rates of use. Thus, an environmental intervention that targets these factors may act synergistically with universal programming implemented in the schools or in other community-based organizations. Including these types of measures and mediation and/or moderation analyses is relatively new in community-based prevention research, and future research should continue to investigate these and other pathways.

Limitations

The number of communities studied is a limitation. Adjusted significance criteria were used in order to protect against Type II errors, and extensive precautions were taken by investigating outliers and influence statistics before assessing the significance of effects. Additionally, generalization of the present findings can best occur to similar rural and small town contexts. Due to the limited sample size only a small number of variables could be entered into the multivariate regression models. Along with increasing the number of distinct communities, future research should also increase the number of community factors investigated and considered.

Conclusion

This study integrated information from prevention community leaders, adolescents, and geographic data to assess the community substance use environment in 28 rural and small town communities. Results demonstrated that the community substance use environment is relatively cohesive, yet it was not a good predictor of community rates of adolescent alcohol and tobacco use; the student-reported norms component of the multidimensional measure has the strongest association with community rates of adolescent substance use. Additionally, though geographic availability of substances does not have a direct association with community rates of adolescent substance use, it has moderate to strong associations with norms perceived by students, and community norms and the availability of substances as perceived by prevention community leaders. As described above, these results have several implications for the measurement, the design, and the corresponding implications that community-level research projects have to early adolescent prevention activities. Future ecological research must give adequate attention to these issues. Understanding the culture of communities, how different aspects of the environment contribute to the culture, and how characteristics associate with adolescent behaviors at different developmental stages is likely

to improve the planning, implementation, and effectiveness of community programs and policies related to positive youth development.

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Table 1

Descriptive statistics for measures

	N	MEAN	STD	MIN	MAX
CL Perceived Norms	28	2.61	0.30	2.16	3.31
In this community, how wrong do most adults think it is for adolescents to drink alcohol? ⁺	28	2.47	0.28	2.00	3.25
Adults in [community_name] think the use of alcohol is a normal part of growing up. [#]	28	2.91	0.40	2.00	3.56
In this community, how wrong do most adults think it is for adolescents to smoke cigarettes? ⁺	28	2.47	0.47	1.55	3.75
Adults in [community_name] think the use of tobacco is a normal part of growing up. [#]	28	2.59	0.35	2.00	3.25
CL Perceived Access	28	3.11	0.26	2.69	3.75
How easy is it for adolescents in your community to obtain alcohol? [^]	28	2.95	0.27	2.40	3.50
How easy is it for adolescents in your community to obtain tobacco? [^]	28	3.28	0.32	2.75	4.00
Geographic Access	28	1.53	1.39	0.15	5.99
The number of alcohol retail locations per 10km of roadway	28	0.94	0.88	0.07	3.97
The number of tobacco retail locations per 10km of roadway	28	0.59	0.52	0.02	2.02
Student Perceived Norms	28	2.83	0.37	2.29	3.49
In general, how many people your age do you think drink beer, wine or liquor? [~]	28	2.96	0.33	2.43	3.70
In general, how many people your age do you think smoke cigarettes? [~]	28	2.69	0.45	1.98	3.48
Community Substance Use Environment (aggregate of standardized subscales)	28				
Community Rate of Adolescent Alcohol Use	28	0.45	0.07	0.31	0.59
Community Rate of Adolescent Cigarette Use	28	0.32	0.09	0.17	0.53

Table Note. Response options for questions include:

⁺ (1) Very Wrong, to (4) Not Wrong at All;

[#] (1) Strongly Disagree, to (4) Strongly Agree;

[^] (1) Very Difficult, to (4) Very Easy;

[~] (1)= None or almost none to (5)= All or almost all

Table 2

Correlations among subscales

	CL Perceived Norms	CL Perceived Access	Geographic Access	Student-reported Norms
CL Perceived Norms	1.00			
CL Perceived Access	.23	1.00		
Geographic Access	.35 ⁺	.47 [*]	1.00	
Student-reported Norms	.28	.30	.43 [*]	1.00
Mean (SD)				

⁺ $p \leq .10$;

^{*} $p \leq .05$