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Short communication

Does substance use moderate the association of neighborhood disadvantage with perceived stress and safety in the activity spaces of urban youth?

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ABSTRACT

Background: This study investigates the association of activity space-based exposure to neighborhood disadvantage with momentary perceived stress and safety, and the moderation of substance use on those associations, among a sample of 139 urban, primarily African American, adolescents.
Method: Geospatial technologies are integrated with Ecological Momentary Assessment (EMA) to capture exposure to neighborhood disadvantage and perceived stress and safety in the activity space. A relative neighborhood disadvantage measure for each subject is calculated by conditioning the neighborhood disadvantage observed at the EMA location on that of the home neighborhood. Generalized estimating equations (GEE) are used to model the effect of relative neighborhood disadvantage on momentary perceived stress and safety, and the extent to which substance use moderates those associations.
Results: Relative neighborhood disadvantage is significantly associated with higher perceived stress, lower perceived safety, and greater substance use involvement. The association of relative neighborhood disadvantage with stress is significantly stronger among those with greater substance use involvement.
Conclusion: This research highlights the value of integrating geospatial technologies with EMA and developing personalized measures of environmental exposure for investigating neighborhood effects on substance use, and suggests substance use intervention strategies aimed at neighborhood conditions. Future research should seek to disentangle the causal pathways of influence and selection that relate neighborhood environment, stress, and substance use, while also accounting for the role of gender and family and peer social contexts.

1. Introduction

Substance use has a detrimental effect on adolescent brain function and development (Lisdahl et al., 2015), and earlier use in adolescence has been found to be an indicator of substance use and misuse in emerging adulthood (Nelson et al., 2015). Evidence suggests that substance use among youth is associated with neighborhood economic disadvantage (Mason et al., 2009; Reboussin et al., 2015), particularly in urban areas where disadvantaged neighborhoods are also often associated with violent crime and other characteristics of neighborhood disorder, which can produce feelings of chronic psychological stress and a lack of safety (Brenner et al., 2013a; Latkin and Curry, 2003). Such neighborhoods also often lack the community support and resources that may buffer the deleterious health effects of stressful neighborhood conditions (Latkin and Curry, 2003). Substance use can serve as a coping mechanism for stressful environments (Jackson et al., 2009),

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and thus users may differ from non-users in their stress response to such environments (Schmeelk-Cone et al., 2003). Exposure to neighborhood disadvantage may be particularly problematic for urban African American youth, who are more likely to reside in poor, segregated neighborhoods, as compared to whites (Massey and Denton, 1993).

Few studies, however, have explicitly investigated the interactions of neighborhood disadvantage, perceptions of stress and safety, and substance use among urban, African American youth. Of those that have, most have employed recall-based survey measures or have been limited to the characteristics of subjects' home neighborhoods (e.g., Brenner et al., 2013b). New methods integrating Global Positioning System (GPS) and Geographic Information System (GIS) technologies with Ecological Momentary Assessment (EMA), referred to by Epstein et al. (2014) as Geographical Momentary Assessment (GMA), allow for the capture of perceived stress and safety in real-time and as georeferenced to an individual's activity space, i.e., places visited outside the home on a routine basis (Mason et al., 2015; Stahler et al., 2013). Capturing exposure outside the home neighborhood is particularly important as research shows that the home and its immediate environs are typically considered safer places than elsewhere among urban youth, even among those residing in relatively disadvantaged neighborhoods (Wiebe et al., 2013). Activity space-based measures of neighborhood exposure capture the contexts of youth development more fully as compared to those utilizing only home neighborhoods (Browning and Soller 2014; Mennis and Mason, 2011).

In the present study, we show how GMA is used to collect integrated data on substance use, momentary perceptions of stress and safety, and activity space exposure to neighborhood disadvantage among a sample of young, urban, primarily African American adolescents. Several research questions are addressed: First, is exposure to neighborhood disadvantage in the activity space associated with substance use? Second, is exposure to neighborhood disadvantage in the activity space associated with perceived stress and safety? And third, if so, does the association of exposure to neighborhood disadvantage with perceived stress and safety differ according to degree of substance use?

2. Methods

2.1. Recruitment and data collection

The present study uses the one year follow-up data from the Social-Spatial Adolescent Study, a longitudinal study based in Richmond, Virginia which examines peer network and geographic mechanisms of adolescent substance use. Study subjects ($N = 248$) were recruited between November 2012 and February 2014, with the majority of participants recruited from an adolescent medicine outpatient clinic. Criteria for study participation included being 13–14 years old, a registered clinic patient, and a Richmond area resident. Written informed consent was obtained from all parents and adolescent participants prior to conducting any research activities. The institutional review boards of both Virginia Commonwealth University and the Richmond City Health department approved the research protocol. For more information on sample recruitment the reader is referred to Mason et al. (2015).

All participants were given a mobile phone with embedded GPS for the duration of the study, which delivered text messages with an embedded URL which provided a link to a secure, web-based EMA survey. Surveys were administered 3–6 times per day over a four day period every other month, yielding 13,266 EMA responses, a 50% response rate. Of those, 3,882 (29%) were completed outside the home, and of those, 1,629 (41%) among 139 subjects had associated GPS coordinates and no missing data for the variables of interest, consistent with other EMA studies employing GPS (Watkins et al., 2014).

2.2. Measures

Participants reported their age, sex, and race during a baseline survey at enrollment. The Adolescent Alcohol and Drug Involvement Scale (AADIS; Moberg and Hahn, 1991), was used to indicate alcohol and drug involvement (including alcohol, marijuana/hashish, hallucinogens, cocaine, barbiturates, PCP, heroin and other opiates, and tranquilizers). The AADIS captures frequency of substance use, time since last use, and age of first use. The scale has possible values ranging between two and 69, where higher scores indicate greater substance use involvement. A score of two indicates never having used a substance (abstinence), and scores greater than 36 indicate a likely substance use disorder. Psychological stress was assessed using the EMA survey item "How stressed out are you right now?" with responses given on a 1 ("Not at all stressed out") to 9 ("Very stressed out") scale. Safety was assessed using the EMA survey item "How safe are you right now?" with responses given on a 1 ("Not at all safe") to 9 ("Very safe") scale. The Pearson correlation between momentary measures of stress and safety is -0.309 ($p < 0.01$).

Neighborhood disadvantage is represented as an index of U.S. Bureau of the Census data variables adapted from Ross and Mirowsky (2001). These data are acquired at the Census tract level, with tracts serving as a proxy for neighborhoods. EMA observations occurred in 172 separate tracts with a median area of 4.5 km^2. The index is calculated as $\left[\left(\frac{a}{10}\right) + \left(\frac{b}{10}\right)\right] - \left[\left(\frac{c}{10}\right) + \left(\frac{d}{10}\right)\right]$, where a is the percentage of households with income below the poverty level, b is the percentage of female-headed households with children, c is the percentage of adults with a bachelor's degree or higher, and d is the percentage of owner-occupied housing units. Higher index values indicate greater neighborhood disadvantage. Using GIS software, each EMA response was attributed with a neighborhood disadvantage value based on the tract within which each EMA response occurred.

We are interested in whether an adolescent is traveling from their home to areas of relatively higher or lower neighborhood disadvantage, as one would expect this transition to create feelings of increased stress and reduced safety as compared to the relative security of the home. Indeed, the effect of place on mood and behavior is rooted in each individual's prior experience, which frames the emotional interpretation of one's environment (Tuan, 1977). To this end, we conditioned the neighborhood disadvantage variable value on the home by subtracting the value observed at a subject's home neighborhood from that observed at his or her EMA response location, a variable which provides a measure of activity space exposure to neighborhood disadvantage that is personalized relative to the residential experience of each adolescent, and which we refer to here as 'relative neighborhood disadvantage.'

2.3. Analytic plan

In order to adjust for both within-person and within-tract dependencies in the data, we employ general estimating equations (GEE) to investigate whether increased relative neighborhood disadvantage is associated with substance use, while controlling for age, sex, and race. An exchangeable correlation is used as we theorize homogeneous within-subject and within-tract correlation. (We also compared goodness-of-fit among the exchangeable, independent, and unstructured working correlation structures using the quasi likelihood under independent model criterion (QIC). The exchangeable structure had slightly better goodness-of-fit for models of safety, whereas the unstructured correlation structure had a slightly better goodness-of-fit for models of stress. Model