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Neighborhoods, daily activities, and measuring health risks experienced in urban environments

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Abstract

Studies of place and health often classify a subject's exposure status according to that which is present in their neighborhood of residence. One's neighborhood is often proxied by designating it to be an administratively defined unit such as census tract, to make analysis feasible. Although it is understood that residential space and actual lived space may not correspond and therefore exposure misclassification may result, few studies have the opportunity to investigate the implications of this issue concretely. A population-based case-control study that is currently underway provides one such opportunity. Adolescent victims of assault in Philadelphia, Pennsylvania, USA, and a control sample of adolescents drawn randomly from the community are being enrolled to study how alcohol consumption and time spent nearby alcohol outlets – individual-level and environmental-level risk factors for violence, respectively – over the course of daily activities relate to the likelihood of being assaulted. Data from a rapport-building exercise consist of hand-drawn sketches that subjects drew on street maps when asked to indicate the area considered their neighborhood. The main data consist of self-reported, detailed paths of the routes adolescents traveled from one location to the next over the course of one full day. Having noticed interesting patterns as the data collection phase proceeds, we present here an analysis conducted with the data of 55 control subjects between 15–19 years old. We found that hand-drawn neighborhoods and activity paths did not correspond to census tract boundaries, and time subjects spent in close proximity to alcohol outlets during their daily activities was not correlated with the prevalence of alcohol outlets in the census tract of their residence. This served as a useful example demonstrating how classifying subjects as exposed based solely on the prevalence of the exposure in the geographic area of their residence may misrepresent the exposure that is etiologically meaningful.

Keywords

Neighborhood; urban health; exposure misclassification; bias; activity patterns; violence; time geography; adolescents; space; USA

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INTRODUCTION

How neighborhood conditions affect health is of great interest to sociologists, geographers, and epidemiologists alike, yet no consensus exists over how "neighborhood" should be operationally defined (O'Campo, 2003). To make studies of neighborhood feasible, one option is to identify the administratively defined geographic unit, such as census tract, in which an individual's home is located, and treat that area as a proxy for the individual's neighborhood. The approach implies that the health-related factors that exist in the area are those that are meaningful to the lives of area residents. This method is common, even though considerable discussion has been dedicated to the problems that can result from using such assignments. Specifically, the biases that can result (Flowerdew, Manley & Sabel, 2008; Geronimus, 2006; Holt, Steel, & Tranmer, 1996; Krieger, Chen, Waterman, Soobader, Subramanian & Carson, 2002; Openshaw, 1984; Scribner, 2000; Wong, 1991; Wrigley, 1995) and the possible irrelevance of administrative boundaries to the health of local residents (Aneshensel & Sucoff, 1996; LaGrange, Ferraro, & Supancic, 1992; Rosenthal & Wilson, 2003). Since the pioneering work by Barker and Wright (Barker & Wright, 1951) on daily activities and by Hägerstrand (1953) on the method of space-time geography, a considerable body of research has been dedicated to understanding details of peoples' actual movements and the health implications that result (Cummins, Curtis, Diez-Roux, & Macintyre, 2007). Interestingly however, many researchers whose work involves assigning subjects to neighborhoods have paid little attention to where people actually spend time.

Overlooking this matter could be particularly problematic in research on locally variable environmental factors that can affect individual health as a result of exposures of a short duration. In studies of violence, for example, considerable research has been dedicated to studying alcohol outlets as a neighborhood-based risk factor (Tatlow, Clapp, & Hohman, 2000; Wechsler, Lee, Hall, Wagenaar & Lee, 2002). The majority of these studies have been ecologic (Morgenstern, 2008), comparing alcohol prevalence rates against violence rates at the level of some areal unit, often census tracts, to test the hypothesis that high outlet density leads to a high rate of violence. To infer that residents of high-density census tracts face an elevated risk of violence makes the assumption that a resident's lived space (the places where he or she spends time and carries out daily activities) is captured adequately by the census tract's boundaries, or that the census tract area itself is a good proxy of the extent to which the resident will be exposed to some health factor of interest.

A recent case-control study measured location- and time-specific exposure levels, and drew attention to this notion of how the risks people face can be dictated by the exposure levels they experience at a given geographic point location at a specific moment in time (Branas, Elliott, Richmond, Culhane, Ten Have & Wiebe, 2009). In extending aspects of this work, we conducted an analysis of one-day activity pattern data to gain insight into how exposure misclassification might be introduced depending upon the method used to measure environmental exposures that can be experienced at different levels and at different places over the course of a subject's daily activities.

METHODS

Design

The analysis presented here is an examination of data that were drawn from a study that is currently underway. The parent study is the Space-Time Adolescent Risk Study, an ongoing population-based case-control study investigating how the nature of adolescents' activities, including weapon carrying and alcohol and drug use, and the locations of their activities relate to the likelihood of being assaulted. The study is guided by routine activities theory (Cohen & Felson, 1979), methodologies including ethnography (Anderson, 1998, 1999), time geography

(Hägerstrand, 1974), cognitive mapping (Krupat, 1985), and the case-control study design (Rothman & Greenland, 1998), and the perspective that daily activities are constrained in space and time, and create opportunities that can be either protective or harmful for health. Spending time near alcohol outlets, an environmental exposure, is a key risk factor of interest.

Sample recruitment

The study is set in the city of Philadelphia, Pennsylvania, USA, an urban area of 350 square kilometers (km^2) that corresponds to 381 contiguous census tracts. The case subjects are child and adolescent males and females treated for assault-related injuries at the Emergency Departments of the Children's Hospital of Philadelphia and the Hospital of the University of Pennsylvania. These are adjoining Level-1 trauma centers located centrally in Philadelphia. The case subjects are compared to a control subject group comprised of a population-based sample of children and adolescents. Because most of the assault patients enrolled as case subjects are male, and the purpose of the control group is to enable comparison with the cases, males comprise the majority of individuals recruited to be controls. The control subjects are recruited through household random-digit dialing (Waksberg, 1978) within an area of 12 contiguous zip codes in Philadelphia. This area was chosen because the majority of the households (approximately 90%) of assault patients treated at the study hospitals are located within this area. Potential subjects are recruited by providing a description of the study over the telephone, inviting them to meet in person either at a research office on campus or at their home, and at that time completing enrollment through an informed consent procedure. Minors (i.e., younger than 18 years old) are recruited only after informed consent from a parent.

Participants

The analysis presented here is based on the data collected from the 15–19 year-old control subjects who have been interviewed to date between January 2007 and April 2009. The criteria to be eligible as a control subject include living in the area comprised by the 12 zip codes, speaking English, and not having impaired cognitive ability. Individuals who are younger than age 18 are provided $50 and individuals who are age 18 or older are provided $100 as remuneration for participating.

Measures

Mapping exercise—All subjects are interviewed in person in either a research office, in the subject's home, or for case subjects, in the hospital. Regardless of location, the interview is conducted in private, out of earshot of others. The interview starts with a mapping exercise, followed by collecting main data of two types. In the mapping exercise, each subject is handed a large laminated color street map of the quadrant of Philadelphia where their home is located and asked to "Take this marker and draw on the map to show me the area you think of as your neighborhood." We use this exercise as a chance for the interviewer to build rapport with the subject, and to have the subject start thinking in terms of places and maps. At the same time, by noting respondents' questions and verbal responses, this exercise provides a chance to gain insight into how children and adolescents envision the concept of neighborhood.

We use general wording in the instructions for the mapping exercise on purpose, and do not provide specific instructions, given that no agreed upon definition of neighborhood exists. To ask for subjects' depictions to conform to any notion of neighborhood that we could articulate would guide the responses and limit our opportunity to learn. Many investigators do ask subjects to describe "conditions of their neighborhood," but do not take an important step and ask where their neighborhood is located or what their notion of neighborhood entails (e.g., (Crum, Lillie-Blanton, & Anthony, 1996). Such questions reveal what subjects have experienced, but not where those experiences occurred. A consequence for land use policy is

that it will not be clear how to improve the urban environment if the locations of those areas that are harmful are unknown.

Activity paths—The main data collection effort first involves administering a standardized questionnaire to assess characteristics of the subject including demographics, health, school performance and hobbies, relationships with friends and family, and perspectives about the areas where they live. Second, seated side by side, the subject and interviewer view the screen of a tablet computer that is running a customized version of ArcEngine software (ESRI, Inc., Redlands, California). The application shows a detailed street map of the subject's residential area as well as, when zoomed out, the entirety of Philadelphia, and contains a high resolution color orthorectified satellite photo of Philadelphia that can be toggled to for an alternate view. The interviewer works with the subject to scroll to the location of the subject's home. The subject is then asked to sequentially report his daily activities by location and time, starting with the time he woke up in the morning. Using a stylus to draw points on the street map, the interviewer creates a graphic that provides a minute-by-minute record of how, when, where, and with whom the subject spent time over the course of the full day (until going to bed, for a duration of up to 24 hours) as he walked or otherwise traveled from location to location and from activity to activity. Cases refer to the day of the shooting/assault; respondents in the control sample are asked to refer to a recent day (within 3 days of the interview) designated at random.

Environment factors—Secondary data are later linked to each subject's reported travel path to provide context and incorporate additional variables for analysis. These data identify the point (longitude-latitude coordinate) locations of alcohol outlets and other environmental exposures and confounding factors in the surrounding environment including characteristics of streets, buildings, and neighborhood populations (e.g., police stations; median household income of households within census blockgroups). Having data with such geographic specificity, these data are used to create map layers through cartographic modeling (Tomlin, 1990) to represent features of the environment with a high degree of accuracy in terms of the specific location in Philadelphia where they exist. When linked to the activity path data, what results are intended to be accurate estimates of the time subjects spent in proximity, during the course of their daily activities, to environmental factors of interest in this research.

Analysis—The primary aims of the parent study, which involve testing hypotheses about how locations of activities relate to the risk of being assaulted, will ultimately be tested by comparing the case subject and control subject groups with mixed effects logistic regression. The analysis presented here is a cross-sectional analysis of the data collected from the 15–19 year-old control subjects interviewed to date. In particular, we tested the assumption (i.e., hypothesis) that the environmental risk factors people encounter during daily activities can be adequately proxied by measuring the levels of those risk factors that are present in their census tract of residence.

As a first step, map images collected during the rapport-building exercise were evaluated and are presented for 10 subjects selected from the total enrolled sample at random as a way to present this hand-drawn information in detail. The analysis on the full enrolled sample then entailed mapping the path of each subject's one-day activities, overlaying that upon maps of Philadelphia census region boundaries, and comparing the amount of geographic overlap between the two. Alcohol outlets were then plotted according to their street address, and multiple approaches to estimating alcohol outlet exposure were calculated. This was done to explore the extent to which levels of exposure would differ depending upon whether exposure was calculated according to where the subject lives or where the subject spent time over the course of up to 24 hours. Regarding exposure over time, we operationalized this concept in two ways: the number of alcohol outlets the subject came within 200 meters of, and within 18

meters of, during the course of their one-day activities. Approximately 200 meters (660 feet) is the distance used for zoning purposes in Philadelphia (e.g., alcohol outlets cannot be within 660 feet of schools). Most streets in Philadelphia are 18 or fewer meters wide (60 feet), and thus for most of the alcohol outlets in Philadelphia, a person could be walking along either side of the street and be in an area that is openly exposed to people who may be leaving an outlet located along that street. Hence our use of these two distances for purposes of this example.

The data were summarized with descriptive statistics and comparisons were made between subgroups with Spearman correlation coefficients, Mann-Whitney tests, and Wilcoxon signed-rank tests. Data on aspects of the subjects' environments were obtained from the Pennsylvania Liquor Control Board and the U.S. Census (Bureau). The analyses were completed with ArcMap version 9.2 (ESRI, Inc., Redlands, California) and Stata version 11 (StataCorp, College Station, Texas). The study was approved by the Institutional Review Boards of the University of Pennsylvania and the Children's Hospital of Philadelphia.

RESULTS

A total of 55 male control subjects between the ages of 15–19 years have been interviewed and are the basis of this analysis. Eighty-six individuals within that age group have been recruited, translating to a participate rate of 67%. The households of the individuals who were enrolled were located in census tracts that, when compared with data from all the census tracts within the recruitment area, had median unemployment rates of 7.2% and 6.9% respectively (signed-rank $z=2.25$, $p<0.05$), median household incomes of $38,585 and $42,692 respectively (signed-rank $z=-1.94$, $p=0.05$), median average family sizes of 3.2 persons and 3.1 persons respectively (signed-rank $z=1.82$, $p=0.07$), and median proportions of adults who were college educated of 8.4% and 10.1% respectively (signed-rank $z=-0.26$, $p=0.79$).

A first set of results describes 10 subjects in detail to convey specifics of the data. A second set of results presents data for the 55 subject sample to provide a more robust picture of the themes the data reveal.

Hand-drawn neighborhoods

The depictions of neighborhoods that were hand drawn by 10 subjects are shown in Figure 1, and Figure 2 shows that same information overlaid with the paths of each subject's one-day activities. Streets, transportation modes, and other contextual information is omitted to protect confidentiality.

Figure 1 reveals that subjects' hand-drawn neighborhoods varied considerably in size and shape. For the most part, subjects depicted their neighborhood by tracing along streets or natural boundaries in the general vicinity of their residence (Subjects 1–7). These areas ranged in size from <0.1 km^2 to 16.6 km^2 (median=6.6 km^2). Interestingly though, one of these subjects depicted his neighborhood as comprised of two non-contiguous land areas (Subject 6) and another subject depicted as his neighborhood an area that did not contain the location of his residence (Subject 7). Additionally, two subjects depicted their neighborhood with a geometric shape (one circle, one diamond) rather than by tracing along boundaries of the built or natural environment, and each of these subjects depicted his neighborhood as being an area that did not contain the location of his residence (Subjects 8 and 9). In a third type of depiction, a subject's neighborhood consisted of three distinct point locations situated within approximately 6 km of his residence (Subject 10). More generally, we found that upon asking subjects to sketch out what they consider to be their neighborhood, a common response was to ask, "Do you mean, where I spend time?" Hence, we formed the impression that the sketches can generally be thought of as subjects' representations of where they spend time.

In no instance did the area depicted by a subject as their hand-drawn neighborhood correspond to the land area defined by one of five administratively defined boundaries that we considered (i.e., census track; census blockgroup; census block; zip code; and "neighborhood," defined in this study according to 69 neighborhood area designations used commonly by local municipal agencies), other than to include segments that followed a street or natural feature that was part of an administrative boundary. We focused on census tracts here given the frequency of their use in neighborhood research, and found that the neighborhoods that subjects drew were land areas that intersected 10.8 census tracts on average (median=12 census tracts).

Figure 2 reveals that subjects' activity paths also varied considerably in terms of distance traveled and the proportion of the path that lay outside their hand-drawn neighborhood. Activity paths ranged in cumulative travel distance from 3.1 km to 57.6 km. The greatest linear distance traveled by the subjects from their homes (i.e., Euclidian distance) ranged from 0.6 km to 19.2 km. Three of the 10 subjects ended their one-day activity path at a residence other than their own, having slept at someone else's home.

Activity paths

Characteristics of the one-day activity paths of all 55 subjects are shown in Table 1. The time spent outside the home during the one-day reporting periods ranged from 0 to 23.5 hours and involved travelling as far as 12.2 km from home, and traveling cumulative distances (i.e., path length) of up to 34.6 km. Cumulative distances and distances travelled from home were highly correlated (Spearman's rho=0.98, $p<0.01$). In most instances (87.8%), it was one of four types of locations that constituted the place along a subject's path that was the farthest point (i.e., Euclidian distance) from their home: school, work, places of recreation, and food stores and restaurants.

The time subjects spent outside their census tracts of residence ranged from 0 to 19.8 hours. The locations where subjects spent outside-the-home time were not defined by their census tract of residence, and it was common to spend the majority of one's outside-the-home time in a location outside one's census tract of residence. Specifically, the proportion of outside-the-home time that subjects spent outside their census tracts of residence ranged from 0% to 99.4%, with a median of 91.5%. That is, half of the subjects spent 91.5% or more of their outside-the-home time in a census tract other than the census tract where their home was located. Subjects spent time in a considerable number of census tracts during their one-day activities, with 6 being the median number of census tracts that subjects' one-day activity paths intersected.

The proportion of interviews for which subjects reported activities for a given day of the week are as follows: Monday 18.2%, Tuesday 20.0%, Wednesday 5.5%, Thursday 10.9%, Friday 14.6%, Saturday 12.7%, Sunday 18.2%. The median values of the greatest linear distances traveled from home were 1.8 km on weekdays and 0.7 km on weekends (Mann-Whitney $z=1.83$, $p=0.07$), indicating that subjects' activities generally involved staying closer to home on weekends. Cumulative distances travelled were generally shorter on weekends as well, being a median of 7.0 km on weekdays and a median of 2.0 km on weekends (Mann-Whitney $z=1.83$, $p=0.07$).

Alcohol outlets

There are approximately 1700 alcohol outlets in Philadelphia (all classes of on-premise and off-premise outlets). The prevalence of alcohol outlets ranges across the 381 census tracts from 0 outlets to 333.3 outlets per 1000 residents, and is highly skewed with a mean of 5.2 outlets per 1000 residents and a median of 1.1 outlets per 1000 residents Most census tracts (91.2%) in the city contain fewer than 10 outlets. Table 2 shows that the prevalence of alcohol outlets in the census tracts where subjects' homes were located varied considerably, ranging from 0

outlets to 46.4 outlets per 1000 residents and from 0 outlets to 5.2 outlets per km of road distance. The number of outlets that subjects came into contact with during their daily activities varied considerably as well. Subjects passed within 18 meters of between 0 and 52 outlets, and within 200 meters of between 0 and 120 outlets, during their one-day activities.

When measured as outlets per 1000 residents, the prevalence of alcohol outlets in the census tracts where subjects' homes were located was not correlated with the number of alcohol outlets that subjects' activity paths came into contact with during one-day activities. Panel A of Figure 3 shows the scatterplot for when contact was defined as being within 18 meters of an outlet (Spearman's rho=0.06, p=0.66) and Panel B shows the scatterplot for when contact was defined as being with 200 meters of an outlet. Similarly, when measured as outlets per km of road distance, the prevalence of alcohol outlets in the census tracts where subjects' homes were located was not correlated with the number of alcohol outlets that subjects' activity paths came into contact with during one-day activities. For the road distance measure, Panel C of Figure 3 shows the scatterplot for when contact was defined as within 18 meters of an outlet (Spearman's rho=−0.07, p=0.60) and Panel D shows the scatterplot for when contact was defined as within 200 meters of an outlet (Spearman's rho=−0.09, p=0.50). Similar results were found when subjects with outlying prevalence values (i.e., below the 10^{th} and above the 90^{th} percentile) were excluded.

DISCUSSION

The notion that exposure levels to environmental risk factors can vary over the course of daily activities has been represented in some research fields (Barker & Wright, 1951; Klepeis, Nelson, Ott, Robinson, Tsang, Switzer et al., 2001; Kwan, 1999; Takahashi, Wiebe & Rodriguez, 2001; Wang & Taylor, 2006; Wikström, Ceccato, Hardie & Treiber, 2009) but remains under-appreciated in large-scale studies of neighborhoods and health. The results of this analysis illustrate how individuals' daily activities may occur in locations away from their homes, cross administrative boundaries, and may result in exposure to environmental agents at very different levels than exist in the area of the individual's home. Viewed in the context of activity pattern research, it is not surprising that routine activities including time spent at school, work, places of recreation, and food stores were prominent among the activities subjects travelled from home to engage in. But the distance of these activity spaces from subjects' homes, and the exposure experiences that occurred en route, are matters that few studies have had the opportunity to quantify, and that large population-based studies of place and health often overlook.

Having used a subset of data that are being collected for another purpose, and that were thus derived with sampling methods and power requirements of that study in mind, the results here do not represent Philadelphia youth as a whole and are not meant to be generalized. Once data collection in the ongoing study is complete, the full sample will be analyzed to investigate in detail the activity pattern data being that are being derived. Non-participation bias and response bias are of course potential threats to the validity of the results presented here and of the larger study as a whole. Information bias may also result if subjects, especially younger ones, had difficultly interpreting the maps. However, even children as young as three years old have been found capable of distinguishing basic features on maps and by age six children may be able to perform way finding skills on maps and aerial photographs (Downs & Liben, 1987; Ellen & Thinus-Blanc, 1987). Descriptions of the instrument validation process will be included in papers that follow and that present final results once data collection is complete. But even in the format presented here, we believe the findings are a helpful illustration of the space-time nature of daily activities and the implications for environmental exposures that result.

In particular, the results demonstrate that administrative boundaries did not define the locations of these subjects' daily activities. This finding in itself is a contribution, given that this character of administrative boundaries is understood in principle but has been examined in few studies that use data on peoples' actual activities. Also, the evidence that activities on weekends occur closer to home than do activities on weekdays contributes support to perspectives like routine activities theory, which contend that people go places to accomplish everyday tasks but which have seldom been studied with data on space-time activities. We acknowledge that an even fuller understanding of the nature of daily activities could have been obtained by stratifying the data further, say by weather on the subject's reporting day, season, or other factors that may constrain activities or affect implications for exposure.

We found the hand-drawn depictions of neighborhoods fascinating. Given that subjects seemed to be trying to convey the locations of places where they spent time, why would a subject's hand-drawn neighborhood depiction and his activity pattern not correspond? We have formed the impression that individuals may very well think of their neighborhoods as being very specific, often small, areas, and they may in fact equate neighborhood with the locations where they spend time. Appreciating the nature and length of the time spent there is key. It would be logical for the locations that subjects drew as their neighborhoods to be the places they hang out; but the fact is that the amount of time they can spend there is limited. What constrains the limits of that time are the competing demands germane to daily existence. Indeed, it was activities of such routine types that took subjects farthest from home. In general, these results are consistent with others' observations that daily routines constrain activities in space and time, and dictate the time windows that remain available for given activities (e.g., Takahashi, Wiebe & Rodriguez, 2001). We have formed the impression that the competing demands for the time of the subjects in this study may have constrained the time that was available to spend hanging out in one's neighborhood. Ours was a small sample, however, and included activity patterns for periods of a single day, and did not evaluate the activities that subjects engaged in except those at the points most distant from home. We will leave this as a topic to be better pursued through studies that follow individuals for multiple days. Based on our impressions from the data as it stands, those studies would do well to ask, Where do subjects spend time? And how much time to they spend there? Both will be key to better understanding "neighborhood."

We used two distance measures to express how subjects were exposed to alcohol outlets over the course of daily activities, and to compare the exposure experienced during activities to the prevalence of alcohol outlets in subjects' census tracts of residence. We believe these served adequately for our example given that the parent study will examine how time spent in proximity to alcohol outlets relates to the likelihood of being assaulted, but these are only two of many ways that activity-related exposure could have been calculated. Other risk factor examples may be even clearer. If bus stop posters that promote cigarette smoking are the environmental risk factor of concern, the number of posters in a child's census tract of residence may be different than the number of posters the child sees. When appreciated as being akin to the notions of available dose and active dose, respectively (Armstrong, White, & Saracci, 1992, p. 12), these two quantities will not be expected to perform equally well in an investigation of how exposure to cigarette advertisements relates to whether children will try smoking.

In sum, the investigator's approach to measuring exposure should be carefully considered in light of the exposure-disease relation under study and the induction period of the exposure of interest. In investigations of environmental agents that are encountered outside the home and that vary in etiologically meaningful ways over the course of daily activities, classifying subjects as exposed based solely on the prevalence of the exposure in the administrative

geographic unit of their residence (e.g., a census tract or ZIP code) may result in exposure misclassification.

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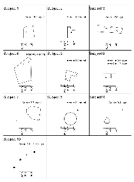

Figure 1. Ten subjects' hand-drawn depictions of the land area they consider to be their neighborhoods, shown in conjunction with the location of their home

Area(s) refers to approximate land area of what each subject hand-drew on a map to represent their "neighborhood."

X = Location of subject's residence.

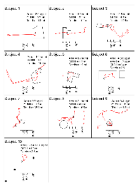

Figure 2. Paths of 10 subjects' 24-hour daily activities, shown in conjunction with their hand-drawn neighborhood depiction and home location

Area(s) refers to approximate land area of what each subject hand-drew on a map to represent their "neighborhood."

GLHD = Greatest linear distance from home.

Tot dis = Route total distance

X = Location of subject's residence.

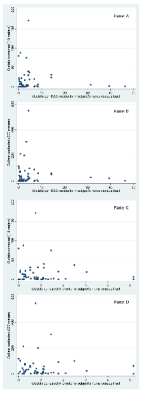

Figure 3. Scatterplots comparing alcohol outlet prevalence in subjects' census tracts of residence and alcohol outlets contacted during one-day activities

TABLE 1

Characteristics of one-day activity paths of 15–19 year-old subjects (n=55)

	Min	Max	Mean (SD)	Median (25%, 75%)
Time (hrs) spent outside home during one-day reporting period	0.0	23.5	7.9 (5.6)	8.3 (3.5, 10.9)
Greatest linear distance from home (km)	0.0	12.2	2.4 (2.7)	1.5 (0.4, 3.9)
Distance travelled (km)	0.0	34.6	8.5 (8.7)	5.2 (1.2, 13.1)
Time (hrs) spent outside census tract of residence during one-day reporting period	0.0	19.8	6.3 (5.5)	7.0 (0.0, 9.4)
Proportion of outside-the-home time that was spent outside census tract of residence (%)	0.0	99.4	71.0 (36.5)	91.5 (56.9, 96.7)
Number of census tracts intersected by subject's one-day activity path	1	34	8.1 (8.5)	6 (1, 10)

Note: 25% and 75% denote the twenty-fifth and seventy-fifth percentiles, respectively.

TABLE 2

Various measures of exposure to alcohol outlets for 15–19 year-old subjects (n=55)

		Min	Max	Mean	Median (25%, 75%)
Alcohol outlet prevalence in subject's census tract of residence	Per 1000 residents	0.0	46.4	5.1 (8.9)	2.3 (0.8, 4.3)
	Per road kilometer	0.0	5.2	1.0 (1.0)	0.8 (0.3, 1.1)
Alcohol outlets contacted during one-day activities	Walked within 18 meters	0	54	3.2 (7.8)	1 (0, 3)
	Walked within 200 meters	0	120	12.1 (19.0)	5 (2, 16)
Cummulative time (minutes) spent near alcohol outlets during one-day activities (within 18 meters)		0.0	340.0	9.7 (50.0)	0 (0, 0)
Cummulative time (minutes) spent near alcohol outlets during one-day activities (within 200 meters)		0.0	370.0	25.0 (67.1)	0 (0, 15)

Note: 25% and 75% denote the twenty-fifth and seventy-fifth percentiles, respectively.