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Collecting Mobility Data with GPS Methods to Understand the HIV Environmental Riskscape Among Young Black Men Who Have Sex with Men: A Multi-city Feasibility Study in the Deep South

Dustin T. Duncan[1], **Basile Chaix**[2,3], **Seann D. Regan**[1], **Su Hyun Park**[1], **Cordarian Draper**[4], **William C. Goedel**[1], **June A. Gipson**[5], **Vincent Guilamo-Ramos**[6], **Perry N. Halkitis**[7], **Russell Brewer**[8], and **DeMarc A. Hickson**[4]

[1]Spatial Epidemiology Lab, Department of Population Health, New York University School of Medicine, New York, NY, USA

[2]Sorbonne Universités, UPMC Univ Paris 06, UMR_S 1136, Pierre Louis Institute of Epidemiology and Public Health, Paris, France

[3]Inserm, UMR_S 1136, Pierre Louis Institute of Epidemiology and Public Health, Paris, France

[4]Center for Research, Evaluation and Environmental & Policy Change, My Brother's Keeper, Inc, Jackson, MS, USA

[5]Center for Community-Based Programs, My Brother's Keeper, Inc, Jackson, MS, USA

[6]Center for Latino Adolescent and Family Health (CLAFH), Silver School of Social Work, New York University, New York, NY, USA

[7]Center for Health, Identity, Behavior and Prevention Studies, Rutgers University School of Public Health, New Brunswick, NJ, USA

[8]Louisiana Public Health Institute (LPHI), New Orleans, LA, USA

Abstract

While research increasingly studies how neighborhood contexts influence HIV among gay, bisexual and other men who have sex with men (MSM) populations, to date, no research has used global positioning system (GPS) devices, an innovative method to study spatial mobility through neighborhood contexts, i.e., the environmental riskscape, among a sample of Black MSM. The purpose of this study was to examine the feasibility of collecting two-week GPS data (as measured

Correspondence to: Dustin T. Duncan.

Compliance with Ethical Standards

Conflicts of interest Authors Dustin T. Duncan, Basile Chaix, Seann D. Regan, Su Hyun Park, Cordarian Draper, William C. Goedel, June A. Gipson, Vincent Guilamo-Ramos, Perry N. Halkitis, Russell Brewer, and DeMarc A. Hickson declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comporable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in this study.

by a pre- and post-surveys as well as objectively measured adherence to GPS protocol) among a geographically-diverse sample of Black MSM in the Deep South: Gulfport, MS, Jackson, MS, and New Orleans LA (n = 75). GPS feasibility was demonstrated including from survey items, e.g. Black MSM reported high ratings of pre-protocol acceptability, ease of use, and low levels of wear-related concerns. Findings from this study demonstrate that using GPS methods is acceptable and feasible among Black MSM in the Deep South.

Keywords

Spatial epidemiology; Neighborhoods; Environmental contexts; Global positioning system (GPS); Feasibility; Men who have sex with men (MSM); Gay and bisexual men's health; HIV; Sexual risk behaviors

Introduction

A growing body of research suggests that neighborhoods influence the health of an array of vulnerable populations [1], including gay, bisexual and other men who have sex with men (MSM) [2–9]. The importance of this ecological context as a critical determinant of risk is supported by decades of behavioral research that characterizes the Black MSM paradox, i.e., the higher HIV infection rates in the context of lower or equal risk behavior compared to MSM of other racial/ethnic backgrounds [10, 11]. Young Black MSM are a population at especially high-risk for HIV, as data from 2016 show that of all new HIV diagnoses among Black MSM, 75% were ages 13–29 years [12]. Despite the potentiality of the neighborhood context to explain variations in HIV among MSM populations, including young Black MSM, the vast majority of neighborhood and health research (including the few studies conducted among MSM) suffer from major limitations. For example, because numerous existing studies tend to rely on the use of administrative boundaries (e.g., ZIP codes, census tracts) as a means of defining neighborhoods, they may suffer from spatial misclassification, which has been defined as the improper measurement of a neighborhood-level exposure based on the definition of the exposure area used [13–15]. More importantly, these studies often focus exclusively on the residential neighborhood context, thereby limiting our ability to assess the full range of neighborhood contexts an individual may experience [16, 17]. However, the concept of spatial polygamy argues that people experience multiple neighborhood contexts in the course of their daily lives [18]. Although no such study has focused exclusively on Black MSM, recent research has shown that MSM are spatially polygamous [19–22], highlighting the need to study the non-residential neighborhood contexts in relation to HIV risk.

Various methods can be used to overcome the limitations of static residential neighborhood definitions and allow for consideration of spatial polygamy. Global positioning system (GPS) methods are a well suited method to address current weaknesses in dominant approaches to study neighborhoods given that GPS methods precisely record location continuously throughout one's daily life and can capture travel patterns between common locations (e.g., social neighborhood and work neighborhood) [15]. Emerging research in spatial epidemiology employing these methods has been conducted. Duncan and colleagues

[23], for example, recently demonstrated the feasibility of a one-week GPS protocol among a sample of 75 young, multi-racial/ethnic MSM in New York City. In this study, prior to wearing the GPS, participants reported high ratings of acceptability and ease of use as well as low levels of wear-related concerns and few concerns related to safety or appearance, which were maintained after completing the one-week GPS device protocol (e.g., upon return of the GPS device no participants reported that it was uncomfortable to wear). No appreciable differences in acceptability and feasibility of these methods were observed by race/ethnicity [23]. One limitation of this study, however, is its use of a 1-week GPS protocol. Compared to 1, 2 weeks may better typify one's usual spatial mobility patterns because regular travel patterns may be overlooked on one-week examination of mobility [15, 24].

Given that racial/ethnic disparities across the HIV continuum of prevention and care [25], particularly those in the six state region (South Carolina, Mississippi, Alabama, Georgia, Louisiana, and Texas) commonly referred to as the Deep South [26, 27], cannot be explained by individual-level factors alone, a focus on neighborhoods and related contextual factors may illuminate the mechanisms contributing to these disparities experienced by Black MSM in this region. Participants in the aforementioned GPS study in New York City were all from a single urban non-Southeastern area and only one-third of participants were Black [23]. Consequently, these findings might not be generalizable across geographies and populations. In addition, to our knowledge, no studies have employed GPS methods among MSM in the Deep South, including among Black MSM in the Deep South. Emerging research has shown that Black MSM in the Deep South may be different than MSM in other geographies, particularly in terms of levels of internalized homophobia and willingness to disclose sexual identity and/or behavior [28–31], and these concerns about privacy may influence one's desire to participate in GPS-related research [32]. An in-depth assessment of the neighborhood contexts of daily life among Black MSM may be particularly important as emerging research has shown that Black MSM exhibit higher degrees of discordance between common neighborhood contexts (e.g., where individuals reside, socialize, or have sex) than White MSM [19–21]. If successful, this GPS-based strategy would have the potential to advance the literature by increasing knowledge of the influence of geography and place on HIV-related behaviors and outcomes and inform the potential spatial targeting of HIV prevention and treatment interventions among Black MSM in the Deep South.

As such, the aim of this study was to measure the acceptability and feasibility of collecting spatial mobility data using GPS methods among a geographically-diverse sample of young Black MSM in the Deep South, a high HIV prevalence region [33, 34], using a highly innovative two-week GPS protocol rarely applied in spatial epidemiology research.

Methods

Study Design and Sample

This feasibility study was primarily designed to understand the feasibility of collecting mobility data using GPS methods over 2 weeks from Black MSM in four areas in the Deep South: Gulfport, MS, Hattiesburg, MS, Jackson, MS and New Orleans, LA. We conducted this study from March 2016 to August 2016 with the goal of recruiting 100 participants,

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with an equal distribution across the four sites (25 participants per study site). Potential participants were considered eligible if they self-reported (1) African American or Black race, (2) biological male sex at birth, (3) being 18 years or older, (4) residence in one of the four study cities, and (5) oral or anal sex with another man within the 6months prior to study enrollment. Participant recruitment was conducted via community-based sampling methods (e.g., word-of-mouth, posted flyers) and enrollment was coordinated and facilitated by community-based (CBOs) and AIDS-servicing organizations (ASOs): My Brother's Keeper (Mississippi) and CrescentCare/The Movement and Priority Health Care (Louisiana).

All protocols were approved by the Sterling Institutional Review Board and all participants were provided extensive details regarding the protocol prior to providing written informed consent. The secondary analyses reported here were determined to be exempt by the New York University School of Medicine Institutional Review Board.

Study Procedures

Participants' involvement with the study lasted for two weeks and consisted of an enrollment (baseline) visit, and two follow-up (mid-point and completion) visits completed at the offices of the partnering CBOs/ASOs. The mid-point survey occurred approximately 7 days after the enrollment visit (usually on Day 7) and the completion visit occurred approximately 7 days after the mid-point survey visit (usually on Day 14). GPS tracking was conducted throughout the two-week GPS protocol. Some participants came in for their visit after fourteen days for various logistical reasons (e.g., busy work or school schedule).

Enrollment Visit—Upon ascertainment of informed consent, study personnel provided the participant with a GPS packet that included the GPS device, charger cord, charger box, a GPS user guide, travel diary, and appointment card. Participants were provided detailed instructions on the use of the GPS device (e.g., how to charge device, when to carry the device) and were instructed to wear the GPS device for seven consecutive days and complete a pen-and-paper GPS use travel diary to report carrying and charging of the GPS device on each day. Participants then completed a survey via audio computer-assisted self-interview (ACASI) technology. This survey included items regarding socio-demographics, recent sexual behaviors, recent alcohol and other drug use, psychosocial factors (e.g., depressive symptoms), geo-social networking app usage patterns, various neighborhood factors, and measures of acceptability of and concerns related to the GPS protocols. Study personnel then scheduled an appointment for the participant to return after 1 week to complete a mid-point assessment of acceptability of the GPS protocol. Participants were given a $25.00 VISA gift card, a $50.00 Shell gas card, and a bag of condoms and water-based lubricants as remuneration for their participation.

Mid-Point Visit—Approximately 7 days later, participants returned to the CBO/ASO offices to return the GPS device given to them during the enrollment visit. Study personnel performed an inventory of the GPS packet to ensure that all components had been returned and were in working condition. Study personnel then ensured that the GPS use travel diary had been completed and downloaded the data from the GPS device onto a dedicated encrypted and password-protected study laptop. The GPS device was then cleared and study

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personnel instructed participants to carry the GPS device on their person for a second week and complete an additional GPS use travel diary. At this visit, participants completed a brief survey via ACASI technology on their experiences wearing the GPS device and their sexual and substance use behaviors in the preceding week, among other topics. Study personnel then scheduled an appointment for the participant to return to the CBO/ASO offices after 1 week to return the GPS device and complete a final post-protocol survey. Participants were given a $75.00 VISA gift card and a bag of condoms and water-based lubricants in recognition of their time.

Completion Visit—After the second week-long protocol, participants returned the GPS device given to them during the mid-point visit. Again, study personnel performed an inventory of the GPS packet and reviewed the travel diary to ensure its completion. Data from the GPS device were then downloaded onto the dedicated study laptop and the device was then cleared. Participants completed a second brief survey via ACASI technology to assess their experiences related to the GPS protocol as well as their sexual and substance use behaviors in the past week, among other topics. At the end of the completion visit, participants received a $100.00 VISA gift card and a bag of condoms and water-based lubricants in appreciation for their time.

GPS Protocol, Data Extraction and Data Cleaning

Prior to implementing the GPS study protocol, key study staff at all locations participated in a GPS Overview and Training Workshop led by NYU's Spatial Epidemiology Lab [23], which oriented the staff to GPS technology and protocol implementation. During the enrollment and midpoint visits, participants were instructed to place the small QStarz BT-Q1000XT GPS device (QStarz International Co., Ltd., Taipei, Taiwan) on their belt (using the manufacturer-provided case), in their pocket or connect the GPS device in the provided case to an item on their person (such as to a key chain or backpack strap) and to complete a GPS use travel diary on a daily basis [23, 35]. Participants were asked to wear the GPS devices at all times except when sleeping, swimming or showering [19]. The GPS devices were programmed to log locations in 30-s intervals prior to distribution, meaning that if a participant wore the GPS device for an hour, and lost no data, there would be 120 data points. The GPS use travel diary, consisting of a series of checkboxes, asked the participant, "Did you charge the GPS monitor today?" and "Did you carry the GPS monitor with you today?" This GPS use diary was meant to help the participant remember to charge the device and carry it throughout the week. Daily text messages were also sent by study personnel to remind the participants to wear the GPS device (morning text message) as well as to charge the GPS device (evening text message), which we have implemented in our previous GPS protocol [23].

GPS data files were downloaded from the devices as.GPX files to a designated study laptop, and extracted and stored on an encrypted and password-protected external hard drive. Post-processing procedures were run on these files and these data were converted into shapefiles for storage into a geodatabase for further post processing, map creation, and storage. These data were processed using several automated processing scripts written in the Python coding language to eliminate duplicate timestamps, high HDOP values (> 3), spatially and

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temporally isolated points and potential GPS data errors consistent with previous research utilizing GPS receivers in health research [36–38]. Spatially and temporally isolated GPS data points were also removed by performing a nearest neighbor analysis as well as computing inter-point distances. Spatially and temporally isolated points were likely due to GPS data errors, and not characteristic of typical or plausible mobility patterns and were removed from further analysis.

Acceptability and Feasibility of GPS Methods

GPS acceptability was assessed using survey-based methods, consistent with previous research [23, 35]. A pre-protocol survey (completed at the enrollment visit) and post-protocol surveys (completed at the mid-point and completion visits) were implemented for this purpose. These surveys included seven items similar across all three-assessment points to facilitate comparisons in acceptability over time [23, 35]. For example, at baseline participants were asked “GPS makes it more interesting to participate in the study” and “I am worried about someone trying to steal the GPS,” while at mid-point and completion follow up visits, participants were asked “GPS made it more interesting to participate in the study” and “I was worried about someone trying to steal the GPS” [23, 35]. Participants were asked to use a 4-point Likert scale from 1 (strongly agree) to 4 (strongly disagree) for these items at the enrollment visit survey. For the analysis, this was dichotomized into “yes” (strongly agree and agree) and “no” (disagree and strongly disagree). At the midpoint and completion visits, participants were asked to use a 5-point Likert scale (with “Neutral”) from 1 (strongly agree) to 5 (strongly disagree) for these items [23, 35]. Responses were combined into “yes” (strongly agree and agree) and “no” (disagree and strongly disagree). Neutral responses were not included in the analysis. In addition, the survey at the mid-point and completion visits also included up to 22 questions examining other aspects of the experience participating in the GPS protocol. The response options for the majority of these questions were “Yes” and “No.” Examples of these questions include: “Overall, was it easy to use the GPS?”; “Did you feel comfortable wearing the GPS?”; “I would participate in another GPS research study”; and “Would you participate in a GPS study that tracked you for 2 weeks?”

Feasibility of these methods was assessed as adherence to the GPS protocol, operationalized as returning the GPS device and self-reporting charging and carrying the GPS device via the travel diary. As additional information, we used objective data derived from the GPS devices to assess the total number of GPS data points, the number of days the device was carried on trips, and the amount of GPS data obtained from the GPS device per day [23, 35]. The number of days of with a certain amount of GPS data was measured using various cutoff values to determine the amount of GPS data. For example, we assessed whether a participant had at least 120 data points on a given day—as this would indicate an hour of GPS data collected. Consistent with previous research [23], cutoff values associated with of 5, 8 and 12 h of GPS data available per day were also to assess the presence of GPS data.

Finally, a map of participants’ GPS data in the three study areas were presented as an additional measure of feasibility, which has been done in previous research [23]. Research has cautioned that there are issues related to privacy and confidentiality that should be

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considered when mapping GPS data [39]. To mitigate these issues, any data collected in the participants' home ZIP codes are obscured. In addition, these data are no longer linked with a unique participant identification number and are therefore anonymized.

Other Variables

Based on the distribution of values, age categories were 19–22, 23–25, and 26–33. Ethnicity included Latino/His-panic or non-Latino/Hispanic. Sexual orientation included gay/homosexual; bisexual; straight/heterosexual; questioning; or I do not identify with any of these. Sexual attraction included attracted to males only; most attracted to males; equally attracted to males and females; attracted to females only; or not sure. Sexual partners in past 6 months included men; women; transgender women; or transgender men. Education levels included less than a 12th grade education; high school diploma or general educational development (GED); community college; trade school or vocational school; bachelor's degree; or graduate degree. Current student status was categorized as full-time or part-time. Employment status groups were defined as "full-time"; "part-time or working occasionally"; and "unemployed." Annual household income was coded as < $12,000; $12,000–$19,999; and $20,000+ categories. Current living situation included alone/by myself, roommate(s) or friend(s); parent(s) or other family member(s); partner or significant other; and "other/unknown." Relationship status was coded as yes or no. Number of places lived in the past 2 years was categorized as 1, 2 and 3 or more. Vehicle ownership was trichotomized as yes, no or unknown. Participants reported their HIV status as negative, positive, or unknown.

Statistical Analysis

First, descriptive statistics were calculated for variables assessed via survey (e.g., socio-demographic variables, acceptability of GPS protocols) and derived from the GPS devices (as described previously). One project site (Hattiesburg) was removed from this analysis due to protocol violations (e.g., participants did not complete the mid-point or completion visits surveys during the protocol period due to research staff error). The analytic sample for the survey data also included participants who answered both the pre-protocol survey at the enrollment visit ($n = 73$) and the post-protocol surveys at the mid-point and completion visits ($n = 72$: midpoint, $n = 71$ completion). Analyses of the survey measures of acceptability were treated as repeated measures as each participant answered comparable measures across all three timepoints. They were therefore compared using conditional logistic regression models, where the comparison is only made within a participant and not between participants. Post-protocol survey measures assessed at mid-point and completion visits were compared using McNemar's test. All statistical analyses were conducted using SAS Version 9.3 (Cary, NC). Statistical significance was determined at $p < 0.05$. Of the participants in the analytic sample, 72 had downloadable and analyzable GPS data across the 2-week GPS protocol. All processing and analyses of the GPS data were conducted using ArcGIS (Version 10.2) and Quantum QGIS (Version 2.6) and geoprocessing scripts were written in Python (Version 2.7) [40]. GPS maps of participants spatial mobility were created in ArcGIS.

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Results

Table 1 shows descriptive statistics of our sample of young Black MSM in the Deep South. A quarter of the sample was HIV-positive (26.1%). The mean age was 24.5 (2.8) years and most participants were 28 years of age or under (93.2%). All participants self-identified as Black or African American. Two-thirds (67.1%) of the participants identified as gay or homosexual; 96% reported that their sexual partners in the past 6 months were men. In addition, approximately 45% of the sample completed high school or less education and over 40% were currently enrolled in school (41.4%). The annual individual-level income was less than $25,000 for 79.7% of the participants. Over three-fourths (76.7%) reported owing a vehicle. Approximately 40% reported being in a committed relationship.

Regarding measures of acceptability assessed at the enrollment, mid-point, and completion visits (Table 2), participants reported high ratings of protocol acceptability (e.g., most participants reported "I felt comfortable with the research study tracking where I go using GPS") and ease of use of the GPS device (e.g., few participants reported "The GPS irritated my skin or was uncomfortable to wear"). In addition, participants reported low levels of wear-related concerns at baseline and follow-up visits. Few concerns related to appearance (17.1%) were reported at the baseline, and some concerns related to loss (28.3%) and stolen (23.4%) were reported at completion visit. Based on our analyses of these repeated measures, acceptability of GPS protocols was maintained over time following the enrollment visit. Apart from two survey measures, these results remained stable from pre- to post-protocol assessments. At enrollment and follow-up (mid-point and completion) participants were asked: "I am concerned that I will lose the GPS" and "I was concerned that I would lose the GPS", respectively, where 14.3, 26.2 and 28.3% reported they "strongly agree or agree" [Mid-point versus Enrollment Conditional Odds Ratio: 3.35 (95% CI: 0.97, 11.66), Completion versus Enrollment Conditional Odds Ratio: 5.58 (95% CI: 1.47, 21.27)]. Finally, at enrollment and follow-up participants were asked, "I am worried about someone trying to steal the GPS" and "I was worried about someone trying to steal the GPS", respectively, where 11.4, 16.4 and 23.4% reported that they "strongly agree or agree" [Mid-point versus Enrollment Conditional Odds Ratio: 3.38 (95% CI: 0.82, 13.89), Completion versus Enrollment Conditional Odds Ratio: 6.08 (95% CI: 1.47, 25.05)].

Table 3 displays the responses to the post-protocol survey questions included at midpoint and completion visits. Overall, the use of GPS methods among study participants was viewed as acceptable. For example, when asked "Overall, was it easy to use the GPS?" 93.1% reported "Yes" at mid-point and 88.6% reported "Yes" at the completion visit, which were not intrinsically different ($p = 0.366$). To the question, "Did you feel comfortable wearing the GPS?" 93.1% reported "Yes" at mid-point and 85.7% reported "Yes" at the completion visit, which were not intrinsically different ($p = 0.059$). In addition, to the question, "Did the GPS device get in the way of your everyday activities?" 5.6% reported "Yes" at mid-point and 7.1% reported "Yes" at the completion visit, which were not different ($p = 0.739$). Furthermore, 2.8% of the sample answered, "Yes" to "Did using the GPS device cause you to alter your behavior?" at midpoint and 7.3% reported "Yes" at the completion visit, which were not intrinsically different ($p = 0.180$). GPS charging and battery was an issue for participants. To illustrate, over 30% of the sample forgot to charge

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the GPS device at night. Interestingly, 97.2% of participants indicated that they would participate in a GPS study that tracked them for 2 weeks and again for 2 weeks 3 months later at the mid-point visit. To the statement, “I had issues or problems with the GPS device during the study” 2.8% reported “Yes” at mid-point and 14.7% reported “Yes” at the completion visit, which was a significant difference (p = 0.011).

Tables 4 shows self-reported number of days charging the GPS device in 2 weeks, and Table 5 shows self-reported carrying of the GPS device on a given day based on the travel diary. Overall, we found that 82.8% (n = 48) participants reported charging the GPS device on 10 or more days, and more than 50% of participants reported carrying the GPS device on their daily travels during the 14 day protocol period. The percentage of participants that carried their GPS for all of their daily travels on a given day had a minimal daily value of 63.8% over the first week and 57.1% during the second week of the protocol. Interestingly, the proportion of men who did not travel on a given day ranged from 4.4 to 17.5% over the two-week period.

Table 6 shows the objective measures of available data derived from the GPS data collected. Of the total of 75 participants enrolled in the study, 96% (n = 72) had GPS data. Of the participants with GPS data, 98.6% (n = 71) had at least 1 h of GPS data for 1 day, 83.3% (n = 60) had at least 1 h for 7 days and 47.2% (n = 34) had at least 1 h on 14 or more days. These measures varied by study location. In Gulfport (*n* = 25), 100% (n = 25) had at least 1 h of data for 1 day and 60.0% (n = 15) had at least 1 h on all 14 days. In Jackson (*n* = 23), 95.7% (n = 22) participants had at least 1 h of data for 1 day and 3 participants (13.0%) had at least 1 h on each of the 14 days of the protocol. In New Orleans (*n* = 24), 100% (n = 24) have at least 1 h for 1 day and 66.7% (n = 16) had at least 1 h on all 14 days. When participant data was disaggregated by the number of hours for which GPS data were available, a range of viable data was found. For example, 95.8% (n = 69) have at least 5 h of GPS data for 1 day and 33.3% (n = 24) had at least 5 h on all 14 days of the study. Using a cutoff threshold of 12 h of data available to indicate a full day of available GPS data, 67 of the total of 72 participants with GPS data or 93.1% had at least 12 h of data on at least 1 day during the study duration.

Figure 1 displays maps of GPS data from three participants, one from each study site, participant ZIP code are overlaid to obscure residential address and demonstrate that these participants spent time outside of his residential neighborhood.

Discussion

Studying Black MSM is critical from intersectionality and health disparities perspectives. At the individual level, theories of intersectionality [41] articulate that such co-occurring social identities (e.g., race, gender, sexual orientation, class) and associated forms of oppression (e.g., racism, transphobia, homophobia, classism) are experienced as interconnected. This perspective recognizes that while Black MSM are indeed Black men, their lived experiences would likely be different than a heterosexual Black man. More specifically, their additional identity as a sexual minority further contributes to discrimination and marginalization both within and outside of the Black community. In effect sexual minority Black men may

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experience multiple minority stressors within various neighborhood environments, including where they may live, work and socialize [42]. As such, examining neighborhood factors and marginalized populations can be obtained by moving beyond examining each identity in isolation, which is the most commonly applied approach in medical and public health research expanding our frame to consider the multiple identities individuals hold and the social and structural contexts in which they hold these identities that shape their "environmenal riskscape."

While multi-city survey studies have been conducted among Black MSM in the Deep South [43], this is the first study utilizing GPS methods to be conducted among any sample of Black MSM in the Deep South and one of few studies in the literature to implement a two-week GPS protocol [15]. To our knowledge, this is the first study to complete a two-week GPS protocol among any sample of MSM. It should be emphasized that collecting GPS data over 2 weeks made it necessary to plan a mid-week interview, for this pilot study which implies logistic burden. In this study, the acceptability and feasibility of these GPS methods were examined among a sample of Black MSM in multiple cities in the Deep South. Overall, we found that it was feasible to distribute GPS devices to be worn for 2 weeks among a sample of Black MSM. Of the enrolled participants who returned GPS devices, 98.6% (n = 71) had at least 1 h of GPS data for 1 day, 83.3% (n = 60) had at least 1 h for 7 days and 47.2% (n = 34) had at least 1 h on 14 or more days. Regarding the 5 h threshold for GPS data, 95.8% (n = 69) had 5 h for at least 1 day, 73.6% (n = 53) had at least 5 h of data on 7 days and 33.3% (n = 24) had at least 5 h of data on 14 days. While our rate for availability of GPS data of 14 days was relatively low, this rate decreased as the time threshold was increased. This reduction may be due to both participants being indoor or even underground locations, although we note though that in the study locations there are very few underground locations. This reduction may also be due non-wear of the device. It is thus important to emphasize that the statistics that we provide on the amount of GPS data available cannot be interpreted in terms of adherence with the protocol. We also note that it is not clear to us why participants in the Jackson site were least adherent to our GPS protocol. After reviewing the findings, we initially thought that because a large proportion of men were currently in school (including at the Jackson site), participants may stay on campus and not have to go anywhere but class, which perhaps resulted in decreased adherence to our protocol and more indoor time. However, to our surprise, our posthoc analyses stratifying percentage of participants with certain cumulated time of GPS data per day, by school enrollment, shows that those enrolled in school had increased GPS data. We also note there was a drop off in the data from 1-week to two-weeks; perhaps, participants were less interested in being a study participant and the uniqueness of the GPS methodology wore off over time.

While studies assessing the acceptability and feasibility of using GPS methods have been conducted in general populations (e.g., non-MSM), there is only one published study (from New York) focused on MSM to which the findings of this study can be compared [23]. In the New York study [23], similarly, the overall GPS return rate after 1 week was 100%. Of the 75 participants (who all had GPS data), all had at least 1 h of data for 1 day and 84% (n = 63) had at least 1 h of data on 7 days [23]. The current study had lower adherence to the GPS protocol for one-week than the New York City study, and the New York City study did

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not conduct a two-week long GPS tracking (as done in the current study). Both studies texted participants to remind them to wear and charge the GPS device, although in the New York City study text messages were only sent once a day. Our findings may be different for various reasons. Perhaps because New York City is population dense and individuals frequently travel shorter distances and outlets for charging are more accessible whereas individual may drive long distances in less population dense areas throughout Mississippi and Louisiana. Most of the sample were students (significantly less so in the New York City study). Also, potentially those living in a highly dense urban environment like New York are more comfortable with technology. Furthermore, the current study was conducted exclusively among Black MSM, who—like Black heterosexual men—have more broadly historically experienced injustices in medical care and medical research and may not have trusted carrying the GPS device on their daily travels [31]. Finally, we recognize that the experience of being a sexual minority man in New York City is not the same as the South, where there is increased homophobia [44]. Therefore, men in the current study may not have wanted to carry the GPS to areas that may become stigmatized or noted as areas where Black MSM socialize or have sex.

Feasibility is determined by a variety of factors. In this study, feasibility was likely influenced by our financial incentive, our use of the travel diary, our sending daily reminder texts to charge their GPS device, as well as the two-week long time frame of our GPS protocol. In addition, participants were allowed to wear the GPS device in their pocket, which may have increased compliance and might explain our finding of a lower proportion of people who reported being concerned with how they looked with the GPS at mid-point and completion. Clarity of the documentation and instructions for use of the GPS device may have also increased GPS use and protocol adherence. The majority of the participant compensation was given after the GPS was returned and the financial incentive may have influenced the high GPS return rate. Furthermore, altruistic motives of study participation were emphasized (i.e., producing useful information to reduce HIV and improve neighborhood conditions for Black MSM through effective policies), which may have also increased participation rate. In addition, we worked with CBOs and ASOs with whom the participants may have already established relationships, increasing acceptability and feasibility. Sampling participants via community-based methods may have also increased feasibility of the study.

Future Research

Neighborhoods as a context for health behaviors and outcomes are beginning to be explored among MSM populations, including Black MSM. However, this research has used crude administrative neighborhood definitions such as ZIP codes [3, 45], despite emerging research suggesting that the neighborhoods in which Black MSM reside, socialize, and have sex may be different [19–21]. Future research with the aim of understanding neighborhood contexts and spatial mobility among larger samples of Black MSM in the Deep South, as well as other marginalized populations (such as transgender women in the Deep South) using GPS methods is warranted, perhaps combined with qualitative methods.

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Future studies should focus on the improvement of adherence to GPS protocols to generate a wider range of mobility data available for analysis to characterize neighborhoods for neighborhood-level health research. For example, participants could be randomized to various incentive structures associated with adherence to the GPS protocols to test the impact of financial incentives on protocol adherence. While there has been some research utilizing existing smartphone applications to collect data on various health behaviors and outcomes among MSM [46–49], we are not aware of any studies that have leveraged the existing location tracking features on smartphones or dedicated smartphone applications to examine neighborhood contexts and spatial mobility among MSM, including Black MSM. Importantly, future research should examine how the characteristics of neighborhood units (as measured by data derived from GPS devices) can influence health among Black MSM. No research has been conducted examining relationships between these GPS "activity space neighborhoods" and health behaviors (e.g., substance use, pre-exposure prophylaxis [PrEP] adherence) among Black MSM.

Building on this feasibility study, we are conducting several additional GPS studies with MSM pouplations, including two large-scale cohort GPS studies with Black MSM—one in Chicago, and another in the Deep South (Jackson, MS and New Orleans, LA). These studies —which are in the field—focus on understanding the influence of neighborhoods on HIV prevention and care behaviors. In these longitudinal studies, 6 months after completing the initial 2-week GPS protocol, participants will carry the GPS device for an additional 2-weeks every six-months over a 1-year study period in one study and two-year study period in another study. Multiple GPS measures (at different time points) can better capture the breadth of people's exposure to neighborhood-level factors.

Findings from the proposed research will impact HIV prevention intervention activities. First, the project will inform specific neighborhood-level policy interventions. For example, increased community efforts to combat lesbian, gay, bisexual and transgender (LGBT) hate crime neighborhood rates through increased local police attention in high-crime locations may be an HIV prevention intervention that can reduce HIV health disparities, if significant associations are found between neighborhood-level LGBT hate crimes and HIV outcomes. Second, from the GPS dataset we will know the travel patterns of Black MSM and therefore be able to identify optimal geographic locations for HIV prevention interventions. This will advance the literature given that such interventions are seldom geographically targeted. Third, examining changes in spatial mobility (i.e. activity spaces) over time will be useful in knowing whether the risks of particular spaces change or remain constant because different neighborhoods will have different risk profiles. Changing risk environments would suggest that prevention requires significant dynamism and fluidity, as well as rapid change-detection feedback loops.

Study Limitations

These findings should be considered in light of their limitations. Social desirability bias may be a concern; for example, participants may over-report their charging and carrying of the GPS device on the travel diary. In addition, reactivity bias is also possible. Known as the "Hawthorne effect," this bias acknowledges that individuals may act differently than they

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would in their typical environments if they know they are being watched. In this case, the knowledge of ongoing location tracking could have caused participants to change their spatial behavior, perhaps avoiding specific locations, though this is not believed to be the case. As described earlier, participants were asked “Did using the GPS device cause you to alter your behavior?” in the post-protocol surveys and 3 and 7% of the sample reported “Yes” at the midpoint and completion visits respectively. In addition, because the participants represent a convenience sample, the sample may have consisted of individuals who were more motivated to be in the study and to complete and adhere to the protocols. While 75 participants is a relatively small sample for general population health research, given that many recent GPS studies have included fewer than 100 participants, this sample size is similar to those in most research utilizing GPS devices. To date, to the best of our knowledge, this study is the largest study utilizing GPS protocols among Black MSM in any geographic region and the only study using these protocols among Black MSM in the Deep South. Given that our participants were recruited from three relatively large cities in Mississippi and Louisiana, these findings might only be generalizable to Black MSM in similar cities in the Southeastern United States.

Conclusion

Findings from this study demonstrate that using GPS methods are acceptable and feasible to collect neighborhood-level data using GPS methods among Black MSM in the Deep South. GPS protocols, therefore, may be among Black MSM populations to understand neighborhood determinants of HIV prevention and treatment behaviors and outcomes. However, future research is needed to increase adherence to GPS protocols.

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References

1. Duncan DT, Kawachi I. Neighborhoods and health. 2nd. New York: Oxford University Press; 2018.
2. Bauermeister J, Eaton L, Stephenson R. A multilevel analysis of neighborhood socioeconomic disadvantage and transactional sex with casual partners among young men who have sex with men living in metro Detroit. Behav Med. 2016; 42(3):197–204. [PubMed: 27337624]
3. Dale SK, Bogart LM, Galvan FH, Wagner GJ, Pantalone DW, Klein DJ. Discrimination and hate crimes in the context of neighborhood poverty and stressors among HIV-positive African-American men who have sex with men. J Community Health. 2016; 41(3):574–83. [PubMed: 26696119]
4. Quinn K, Voisin DR, Bouris A, Schneider J. Psychological distress, drug use, sexual risks and medication adherence among young HIV-positive Black men who have sex with men: exposure to community violence matters. AIDS Care. 2016; 28(7):866–72. [PubMed: 26917328]
5. Phillips G II, Birkett M, Kuhns L, Hatchel T, Garofalo R, Mustanski B. Neighborhood-level associations with HIV infection among young men who have sex with men in Chicago. Arch Sex Behav. 2015; 44(7):1773–86. [PubMed: 26168977]

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6. Kelly BC, Carpiano RM, Easterbrook A, Parsons JT. Sex and the community: the implications of neighbourhoods and social networks for sexual risk behaviours among urban gay men. Sociol Health Illn. 2012; 34(7):1085–102. [PubMed: 22279969]

7. Carpiano RM, Kelly BC, Easterbrook A, Parsons JT. Community and drug use among gay men the role of neighborhoods and networks. J Health Soc Behav. 2011; 52(1):74–90. [PubMed: 21362613]

8. Bauermeister JA, Connochie D, Eaton L, Demers M, Stephenson R. Geospatial indicators of space and place: a review of multilevel studies of HIV prevention and care outcomes among young men who have sex with men in the United States. J Sex Res. 2017; 54(4–5):446–64. [PubMed: 28135857]

9. Bauermeister JA, Eaton L, Andrzejewski J, Loveluck J, Van-Hemert W, Pingel ES. Where you live matters: structural correlates of HIV risk behavior among young Men who have sex with men in Metro Detroit. AIDS Behav. 2015; 19(12):2358–69. [PubMed: 26334445]

10. Halkitis PN, Kapadia F, Siconolfi DE, et al. Individual, psychosocial, and social correlates of unprotected anal intercourse in a new generation of young men who have sex with men in New York City. Am J Public Health. 2013; 103(5):889–95. [PubMed: 23488487]

11. Forney JC, Miller RL, Team CPS. Risk and protective factors related to HIV-risk behavior: a comparison between HIV-positive and HIV-negative young men who have sex with men. AIDS Care. 2012; 24(5):544–52. [PubMed: 22292776]

12. HIV Among African American Gay and Bisexual Men. 2018. https://www.cdc.gov/hiv/group/msm/bmsm.html. Accessed April 9, 2018

13. Duncan DT, Kawachi I, Subramanian S, Aldstadt J, Melly SJ, Williams DR. Examination of how neighborhood definition influences measurements of youths’ access to tobacco retailers: a methodological note on spatial misclassification. Am J Epidemiol. 2014; 179(3):373–81. [PubMed: 24148710]

14. Duncan DT, Tamura K, Regan SD. , et al. Quantifying spatial misclassification in exposure to noise complaints among low-income housing residents across New York city neighborhoods: a global positioning system (GPS) study. Ann Epidemiol. 2016.

15. Duncan DT, Regan SD, Chaix B. Operational Neighborhood Definitions in health research: spatial misclassification and other issues In: Duncan DT, Kawachi I, editors Neighborhoods and health. 2nd. Oxford: Oxford University Press; 2018.

16. Shareck M, Kestens Y, Frohlich KL. Moving beyond the residential neighborhood to explore social inequalities in exposure to area-level disadvantage: results from the interdisciplinary study on inequalities in smoking. Soc Sci Med. 2014; 108:106–14. [PubMed: 24632055]

17. Chum A, Patricia O. Contextual determinants of cardiovascular diseases: overcoming the residential trap by accounting for non-residential context and duration of exposure. Health Place. 2013; 24:73–9. [PubMed: 24056364]

18. Matthews SA. Spatial polygamy and the heterogeneity of place: studying people and place via egocentric methods. In: Burton LM, Kemp SP, Leung M, Matthews SA, Takeuchi DT, editorsCommunities, neighborhoods, and health: expanding the boundaries of place. New York: Springer; 2011. 35–55.

19. Duncan DT, Kapadia F, Halkitis PN. Examination of spatial polygamy among young gay, bisexual, and other men who have sex with men in New York City: the P18 cohort study. Int J Environ Res Public Health. 2014; 11(9):8962–83. [PubMed: 25170685]

20. Koblin BA, Egan JE, Nandi V, et al. Congruence of home, social and sex neighborhoods among men who have sex with men, NYCM2M study. J Urban Health. 2017; 94(3):364–74. [PubMed: 27646852]

21. Koblin BA, Egan JE, Rundle A, et al. Methods to measure the impact of home, social, and sexual neighborhoods of urban gay, bisexual, and other men who have sex with men. PLoS ONE. 2013; 8(10):e75878. [PubMed: 24146785]

22. Vaughan AS, Kramer MR, Cooper HL, Rosenberg ES, Sullivan PS. Activity spaces of men who have sex with men: an initial exploration of geographic variation in locations of routine, potential sexual risk, and prevention behaviors. Soc Sci Med. 2017; 175:1–10. [PubMed: 28040577]

23. Duncan DT, Kapadia F, Regan SD, et al. Feasibility and acceptability of global positioning system (GPS) methods to study the spatial contexts of substance use and sexual risk behaviors among

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young men who have sex with men in New York City: a P18 cohort sub-study. PLoS ONE. 2016; 11(2):e0147520. [PubMed: 26918766]

24. Krenn PJ, Titze S, Oja P, Jones A, Ogilvie D. Use of global positioning systems to study physical activity and the environment. Am J Prev Med. 2011; 41(5):508–15. [PubMed: 22011423]
25. Millett GA, Peterson JL, Flores SA, et al. Comparisons of disparities and risks of HIV infection in Black and other men who have sex with men in Canada, UK, and USA: a meta-analysis. The Lancet. 2012; 380(9839):341–8.
26. Reif S, Pence BW, Hall I, Hu X, Whetten K, Wilson E. HIV diagnoses, prevalence and outcomes in nine southern states. J Community Health. 2015; 40(4):642–51. [PubMed: 25524210]
27. Reif SS, Whetten K, Wilson ER, et al. HIV/AIDS in the Southern USA: a disproportionate epidemic. AIDS Care. 2014; 26(3):351–9. [PubMed: 23944833]
28. Smallwood SW, Spencer SM, Ingram LA, Thrasher JF, Thomp-son-Robinson MV. Different dimensions: internalized homonega-tivity among African American men who have sex with men in the Deep South. J Homosex. 2017; 64(1):45–60. [PubMed: 27042869]
29. Smallwood SW, Spencer SM, Ingram LA, Thrasher JF, Thompson-Robinson MV. Examining the relationships between religiosity, spirituality, internalized homonegativity, and condom use among African American men who have sex with men in the deep south. Am J Men's Health. 2015; 11(2):196–207.
30. Truong N, Perez-Brumer A, Burton M, Gipson J, Hickson D. What is in a label? Multiple meanings of 'MSM'among same-gender-loving Black men in Mississippi. Glob Public Health. 2016; 11(7–8):937–52. [PubMed: 26950431]
31. Eaton LA, Driffin DD, Kegler C, et al. The role of stigma and medical mistrust in the routine health care engagement of black men who have sex with men. Am J Public Health. 2015; 105(2):e75–82.
32. Paz-Soldan VA, Stoddard ST, Vazquez-Prokopec G, et al. Assessing and maximizing the acceptability of global positioning system device use for studying the role of human movement in dengue virus transmission in Iquitos, Peru. Am J Trop Med Hyg. 2010; 82(4):723–30. [PubMed: 20348526]
33. Lieb S, Prejean J, Thompson DR, et al. HIV prevalence rates among men who have sex with men in the southern United States: population-based estimates by race/ethnicity. AIDS Behav. 2011; 15(3):596–606. [PubMed: 20872062]
34. Oster AM, Dorell CG, Mena LA, Thomas PE, Toledo CA, Heffelfinger JD. HIV risk among young African American men who have sex with men: a case–control study in Mississippi. Am J Public Health. 2011; 101(1):137–43. [PubMed: 21088266]
35. Duncan DT, Regan SD, Shelley D, et al. Application of global positioning system methods for the study of obesity and hypertension risk among low-income housing residents in New York City: a spatial feasibility study. Geospat Health. 2014; 9(1):57. [PubMed: 25545926]
36. Kerr J, Duncan S, Schipperijn J. Using global positioning systems in health research: a practical approach to data collection and processing. Am J Prev Med. 2011; 41(5):532–40. [PubMed: 22011426]
37. Kerr J, Marshall S, Godbole S, et al. The relationship between outdoor activity and health in older adults using GPS. Int J Environ Res Public Health. 2012; 9(12):4615–25. [PubMed: 23330225]
38. Wolf J, Guensler R, Bachman W. Elimination of the travel diary: experiment to derive trip purpose from global positioning system travel data. Transp Res Rec. 2001; 1768:125–34.
39. Haley DF, Matthews SA, Cooper HL, et al. Confidentiality considerations for use of social-spatial data on the social determinants of health: sexual and reproductive health case study. Soc Sci Med. 2016; 166:49–56. [PubMed: 27542102]
40. Python Software Foundation. Python Language Reference, version 2.7. Available at http://www.python.org
41. Crenshaw K. Demarginalizing the intersection of race and sex: A black feminist critique of antidiscrimination doctrine, feminist theory and antiracist politics. U Chi Legal F. 1989; 139
42. Meyer IH. Prejudice, social stress, and mental health in lesbian, gay, and bisexual populations: conceptual issues and research evidence. Psychol Bull. 2003; 129(5):674–97. [PubMed: 12956539]

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

43. Hickson DA, Truong NL, Smith-Bankhead N, et al. Rationale, design and methods of the ecological study of sexual behaviors and HIV/STI among African American men who have sex with men in the Southeastern United States (The MARI Study). PLoS ONE. 2015; 10(12):e0143823. [PubMed: 26700018]

44. Thorpe RJ, Halkitis PN. Biopsychosocial determinants of the health of boys and men across the lifespan. Behav Med. 2016; 42(3):129–31. [PubMed: 27337616]

45. Frye V, Nandi V, Egan JE, et al. Associations among neighborhood characteristics and sexual risk behavior among black and white MSM living in a major urban area. AIDS Behav. 2017; 21(3): 870–90. [PubMed: 27817101]

46. Duncan DT, Goedel WC, Mayer KH, et al. Poor sleep health and its association with mental health, substance use, and condomless anal intercourse among gay, bisexual, and other men who have sex with men. Sleep Health. 2016; 2(4):316–21. [PubMed: 29073390]

47. Goedel WC, Duncan DT. Geosocial-networking app usage patterns of gay, bisexual, and other men who have sex with men: survey among users of Grindr, a mobile dating app. JMIR Public Health Surveill. 2015.

48. Goedel WC, Halkitis PN, Greene RE, Duncan DT. Correlates of awareness of and willingness to use pre-exposure prophylaxis (PrEP) in gay, bisexual, and other men who have sex with men who use geosocial-networking smartphone applications in New York City. AIDS Behav. 2016.

49. Winetrobe H, Rice E, Bauermeister J, Petering R, Holloway IW. Associations of unprotected anal intercourse with Grindr-met partners among Grindr-using young men who have sex with men in Los Angeles. AIDS Care. 2014; 26(10):1303–8. [PubMed: 24754563]

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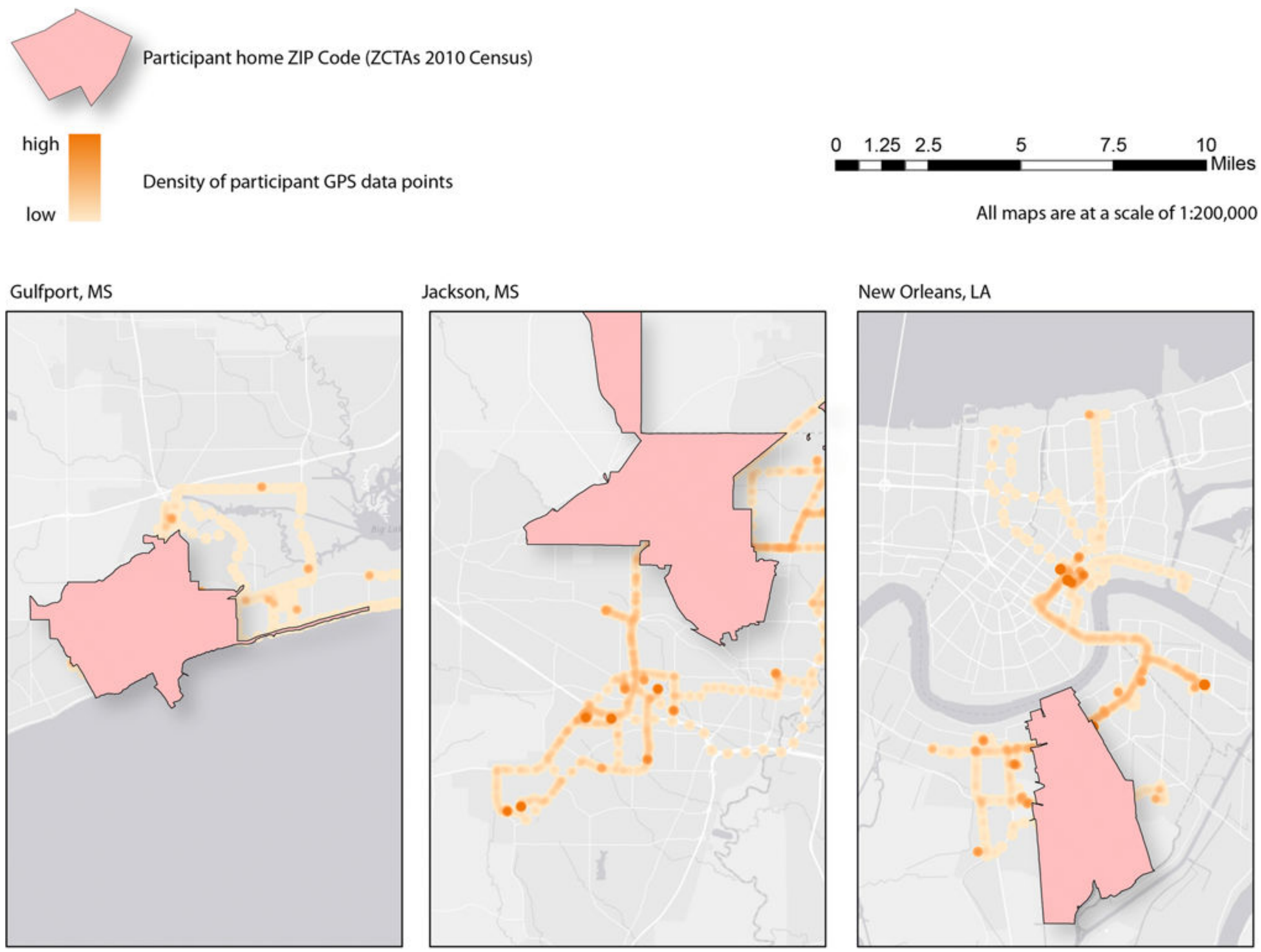

Fig. 1.

GPS data for a participant in Gulfport, MS, Jackson MS, and New Orleans, LA

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Table 1

Sample socio-demographics (n = 73)

Variable	% (*n*)
Demographics	
Age, years	
19–22	30.1 (22)
23–25	32.9 (24)
26–33	37.0 (27)
Latino/Hispanic ethnicity (missing = 2)	5.6 (4)
Race (missing = 2)	
Black	95.9 (70)
Black and Mixed Race: Asian, Pacific Islander, American Indian, Alaska Native)	2.8 (2)
Black and mixed race: other Sexual orientation (missing = 3)	1.4 (1)
Gay or homosexual	67.1 (47)
Bisexual	20.0 (14)
Straight or heterosexual	2.9 (2)
Questioning	2.9 (2)
I do not identify with any of these	7.1 (5)
Sexual attraction[a] (missing = 3)	
Attracted to males only	28.6 (20)
Most attracted to males	57.1 (40)
Equally attracted to males and females	8.6 (6)
Attracted to females only	4.3 (3)
Not sure	1.4 (1)
Sexual partners in past 6 months (missing = 4)	
Men	95.7 (66)
Women	10.1 (7)
Transgender women	0.0 (0)
Transgender men	1.5 (1)
Socioeconomics	
Education (missing = 3)	
High school diploma or less	5.7 (4)
High School Diploma or GED	38.6 (27)
Community college/trade school/vocational school	37.1 (26)
Bachelor's degree	14.3 (10)
Graduate degree	4.3 (3)
Currently enrolled in school (missing = 3)	
Yes	41.4 (29)
No	58.6 (41)
Full-time students	
Yes	62.1 (18)
No	37.9 (11)

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Variable	% (*n*)
Annual Household Income (missing = 4)	
< $12,000	42.0 (29)
$12,000–$24,999	37.7 (26)
$25,000+	20.3 (14)
Current Employment status (missing = 3)	
Full-time	47.1 (33)
Part-time or working occasionally	30.0 (21)
Unemployed	22.9 (16)
Current living situation	
Alone/by myself	26.0 (19)
Roommate(s)/friend(s)	31.5 (23)
Parent(s)/other family members	27.4 (20)
Partner/significant other	9.6 (7)
Other/unknown	5.5 (4)
Committed relationship (missing = 3)	41.4 (29)
Number of places lived in past 2 years (missing = 3)	
One (1)	38.6 (27)
Two (2)	44.3 (31)
Three or more	17.1 (12)
Vehicle ownership	
Yes	76.7 (56)
No	19.2 (14)
Unknown	4.1 (3)
Study site	
Jackson, MS	34.3 (25)
Gulfport, MS	34.3 (25)
New Orleans, LA	31.5 (23)
HIV status (missing = 4)	
HIV-infected	26.1 (18)
HIV-uninfected	71.0 (49)
Unknown/do not know	2.9 (2)

Valid percentages are presented (i.e. missing data are excluded from the calculations)

GED general educational development

[a] Not mutually exclusive

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Table 2

Comparison of pre- and post-gps acceptability survey items

Question[a]	Enrollment GPS survey (n = 70)—strongly agree/agree (%)	Midpoint GPS survey (n = 72)—strongly agree/agree (%)	Completion GPS survey (n = 69)—strongly agree/agree (%)	Overall conditional odds ratio (95% CI)	Midpoint versus enrollment conditional odds ratio (95% CI)	Completion versus enrollment conditional odds ratio (95% CI)
1. I am (felt) comfortable with the research study tracking where I go using GPS.	97.1	91.3	97.0	0.63 (0.21, 1.93)	0.10 (0.01, 1.32)	0.41 (0.03, 5.31)
2. GPS makes (made) it more interesting to participate in the study.*	92.9	95.2	100.0	3.46 (0.83, 14.38)	2.00 (0.37, 10.92)	–
3. I am (was) worried about someone trying to steal the GPS.	11.4	16.4	23.4	**2.40 (1.21, 4.77)**	3.38 (0.82, 13.89)	**6.08 (1.47, 25.05)**
4. The GPS (irritated my skin or was) seems uncomfortable to wear.	15.7	6.0	17.2	1.14 0.64, 2.02)	0.33 (0.09, 1.25)	1.42 (0.48, 4.14)
5. I am (was) concerned that I will (would) lose the GPS.	14.3	26.2	28.3	**2.36 (1.22, 4.59)**	3.35 (0.97, 11.66)	**5.58 (1.47, 21.27)**
6. I am worried about my safety wearing the GPS.	11.4	4.4	17.5	1.55 (0.82, 2.93)	0.29 (0.06, 1.41)	2.64 (0.77, 9.08)
7. I am (was) concerned about how I will look (looked) wearing the GPS.	17.1	7.5	14.5	1.00 (0.55, 1.81)	0.41 (0.12, 1.47)	1.08 (0.34, 3.43)

Bold values are statistically significant

GPS global positioning system, *CI* confidence interval

[a]No estimate was computed when comparing the baseline survey responses to those of the completion survey responses because all of the participants who completed the completion survey agreed that GPS made it interesting to participate in the study

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Table 3

Affirmative ('YES') responses with questions about GPS device

Statements/questions	Mid-point (n = 72) % (n)	Completion[b] (n = 71) % (n)	P value[c]
1. I had issues or problems with the GPS device during the study[a]	2.8 (2)	14.7 (10)	**0.011**
2. Did you have problems turning the GPS device on or off?	5.6 (4)	4.3 (3)	0.655
3. Did you forget to charge the GPS device at night?	31.9 (23)	36.2 (25)	0.450
4. Did you forget where to put the GPS device?	5.6 (4)	5.7 (4)	1.00
5. Do you think the GPS device was too big?	6.9 (5)	7.1 (5)	1.00
6. Do you think the GPS device was too small?	2.8 (2)	2.9 (2)	1.00
7. Did the GPS run out of battery during the day?	31.9 (23)	32.9 (23)	1.00
8. Overall, was it easy to use the GPS?	93.1 (67)	88.6 (62)	0.366
9. Did you have any problems with charging the GPS?	5.6 (4)	7.1 (5)	0.706
9. Did you have any problems carrying or wearing the GPS?	6.9 (5)	4.3 (3)	0.706
10. Were you able to solve any problems you had with the GPS?	69.4 (50)	65.7 (46)	0.467
11. Did you feel comfortable wearing the GPS?	93.1 (67)	85.7 (60)	0.059
12. Did the GPS device get in the way of your everyday activities?	5.6 (4)	7.1 (5)	0.739
13. Was the battery life of the GPS too short?	20.8 (15)	17.1 (12)	0.467
14. Did you forget to wear the GPS device daily?	12.5 (9)	13.0 (9)	0.366
15. I would participate in another GPS research study.	91.7 (66)	87.0 (60)	0.257
16. Did using the GPS device cause you to alter your behavior?	2.8 (2)	7.3 (5)	0.180
17. Were there any activities that were difficult to do with the GPS on?	1.4 (1)	5.8 (4)	0.180
18. Was the GPS device inconvenient to carry/wear?	8.3 (6)	5.8 (4)	0.527
19. Was it a chore to wear the GPS device?	18.1 (13)	14.5 (10)	0.593
20. Do you like the look of the GPS device?	66.2 (47)	63.8 (44)	0.513
21. Would you be willing to participate in a GPS study that asked you to wear a GPS device for 2 weeks and then come back 3 months later and wear a GPS device for another 2 weeks?	97.2 (70)	–	–
22. Would you be willing to participate in a GPS study that asked you to wear a GPS device for 4 weeks and then come back 3 months later and wear a GPS device for another 4 weeks?	95.8 (69)	–	–

Bold value is statistically significant

[a]For question #1 ("I had issues or problems with the GPS device during the study"), response options were "strongly agree", "agree", "neutral", "disagree" and "strongly disagree" and were dichotomized as "Yes" ("strongly agree/agree") and "No" ("strongly disagree/disagree/neutral")

[b]Contains missing data. Respondents for each question ranges from 69 to 71

[c]McNemar's Test was used to compute p values

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Table 4

Travel diary reported GPS charging (n = 58 with complete data)

"Did you charge the GPS monitor today?"	
	Yes (%)
Days	
1	0 (0)
2	0 (0)
3	1.7 (1)
4	1.7 (1)
5	0 (0)
6	0 (0)
7	5.2 (3)
8	3.5 (2)
9	5.2 (3)
10	3.5 (2)
11	12.1 (7)
12	15.5 (9)
13	12.1 (7)
≥ 14	39.7 (23)

17 participants with missing values for travel diary data are excluded: 11.8% (n = 2) had one partial week of data, 64.7% (n = 11) had one full week of data, 5.9% (n = 1) had one full week of data and a partial second week of data, 11.8% (n = 2) did not respond at least 1 day during the 2 weeks, and 11.8% (n = 2) had no travel data for the two-week GPS protocol

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Table 5

Travel diary reported GPS carrying

"Did you carry the GPS monitor with you today?"				
	Yes—for all journeys (%)	**Yes—for some journeys (%)**	**No—but did make journeys (%)**	**Did not travel today (%)**
Day				
1	76.8 (53)	17.4 (12)	1.5 (1)	4.4 (3)
2	72.5 (50)	18.8 (13)	1.5 (1)	7.3 (5)
3	68.1 (47)	23.2 (16)	4.4 (3)	4.4 (3)
4	63.8 (44)	17.4 (12)	10.1 (7)	8.7 (6)
5	67.7 (46)	14.7 (10)	7.4 (5)	10.3 (7)
6	67.2 (45)	14.9 (10)	3.0 (2)	14.9 (10)
7	73.9 (48)	18.5 (12)	1.5 (1)	6.2 (4)
8	82.5 (52)	12.7 (8)	0 (0)	4.8 (3)
9	69.8 (44)	20.6 (13)	1.6 (1)	7.9 (5)
10	67.7 (42)	17.7 (11)	4.8 (3)	9.7 (6)
11	57.1 (36)	25.4 (16)	9.5 (6)	7.9 (5)
12	73.0 (46)	14.3 (9)	3.2 (2)	9.5 (6)
13	68.3 (43)	12.7 (8)	1.6 (1)	17.5 (11)
≥ 14	73.0 (46)	11.1 (7)	4.8 (3)	11.1 (7)

Contains missing data. Respondents for each question ranges from 63 to 69

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Table 6

Percentage of participants with certain cumulated time of GPS data per day, by different time thresholds (n = 72)

Days	GPS time threshold			
	1-h (%)	5-h (%)	8-h (%)	12-h (%)
1	98.6	95.8	94.4	93.1
2	98.6	94.4	90.3	81.9
3	94.4	90.3	88.9	76.4
4	93.1	86.1	81.9	70.8
5	91.7	83.3	75.0	66.7
6	86.1	77.8	68.1	62.5
7	83.3	73.6	61.1	54.2
8	80.6	69.4	55.6	48.6
9	72.2	61.1	52.8	44.4
10	69.4	56.9	48.6	43.1
11	69.4	52.8	44.4	36.1
12	62.5	45.8	37.5	26.4
13	55.6	41.7	27.8	20.8
≥ 14	47.2	33.3	23.6	13.9