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Feasibility of Using Global Positioning Systems (GPS) with Diverse Urban Adults: Before and After Data on Perceived Acceptability, Barriers, and Ease of Use

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Abstract

Background—Global positioning systems (GPS) have emerged as a research tool to better understand environmental influences on physical activity. This study examined the feasibility of using GPS in terms of perceived acceptability, barriers, and ease of use in a racially/ethnically diverse sample of lower socioeconomic position (SEP).

Methods—Data were from two pilot studies involving a total of 170 African American, Hispanic, and White urban adults with a mean (standard deviation) age of 47.8 (±13.1) years. Participants wore a GPS for up to seven days. They answered questions about GPS acceptability, barriers (wear-related concerns), and ease of use, before and after wearing the GPS.

Results—We found high ratings of GPS acceptability and ease of use and low levels of wear-related concerns, which were maintained after data collection. While most were comfortable with their movements being tracked, older participants ($p<0.05$) and African Americans ($p<0.05$) reported lower comfort levels. Participants who were younger, with higher education, and low incomes were more likely to indicate that the GPS made the study more interesting ($p<0.05$). Participants described technical and wear-related problems, but few concerns related to safety, loss, or appearance.

Conclusions—Use of GPS was feasible in this racially/ethnically diverse, lower SEP sample.

Keywords

Global positioning system; Environment; Physical activity; Feasibility; Perceptions

Introduction

Over the past decade, a large body of research has examined relationships between geographic environments and weight-related behaviors and outcomes, including physical activity.[1–3] For example, several studies have shown links between physical activity behaviors and environmental features such as park accessibility, walkability, and aesthetic qualities.[4–13] Much of the research conducted to date has focused on exposure to environmental features of the residential neighborhood[14] and thus ignores exposure to other places where individuals spend time. Studies adopting global positioning system (GPS) technologies represent a relatively new approach for identifying environmental influences on weight-related behaviors, including physical activity, in children and adults. For example, among other uses,[15] GPS has been employed to measure travel routes or behaviors,[16–18] patterns of indoor and outdoor activity,[19, 20] and where physical activity occurs.[21–23]

Of the methodological studies conducted to date on use of GPS technology, most have focused on feasibility in terms of GPS performance, data processing, or participant compliance.[19, 24] While these are important elements of feasibility, little is known about feasibility in terms of perceived acceptability, barriers, and ease of using GPS, especially in racially and ethnically diverse and lower socioeconomic groups that are at the highest risk for physical inactivity and obesity.[25, 26] Further, little is known about the extent to which participants' perceptions of acceptability, barriers, and ease of use change after using GPS. This has limited our understanding of potential challenges or opportunities associated with use of this technology across diverse racial, ethnic, and socioeconomic groups.

Drawing on data from two sequential pilot studies [Activity Space Measurement Study (ASMS), Detroit Activity Space Environments Study (DASES)] involving a total of 170 participants, we examined feasibility in terms of perceived acceptability, barriers (wear-related concerns), and ease of using GPS with racially and ethnically diverse adult samples of low to moderate socioeconomic position (SEP) in three communities in Detroit, Michigan. Specifically, GPS feasibility we examined whether perceived GPS acceptability, wear-related concerns, or ease of use differed (a) between baseline and follow-up (after wearing the GPS) and (b) by participant demographic characteristics. We also described problems participants identified with the GPS.

Methods

Overview of Data Collection

Implemented sequentially, the ASMS and DASES were designed to pilot test methodology to measure "activity spaces" (spaces within which people move or travel during the course of their day-to-day activities)[27, 28] of urban residents. Specifically, we assessed the feasibility of using GPS to measure activity spaces and examining environmental exposures (e.g., density of parks and fast food outlets) in this space that may affect weight-related behaviors (physical activity, dietary intakes) and outcomes.[29] Both studies were conducted in the eastside, southwest, and northwest communities of Detroit, Michigan, as part of larger studies (described in greater detail below) being implemented by the Detroit Healthy Environments Partnership, a community-based participatory research partnership comprised of representatives from community-based organizations, health services organizations, and academic institutions (see Acknowledgements). Data collection in both studies consisted of three phases: baseline interview, a multiday study period, and follow-up interview.

In both studies, participants were asked to wear the Foretrex 201 (Garmin, Olathe, KS), a wrist-mounted GPS receiver, during the study period. They received verbal and printed instructions in the baseline interview on its use, including demonstrations. They were asked to wear the GPS on their left wrist from morning awakening until the time they went to bed at night (except during bathing or other water activities) and to recharge the GPS overnight (and as needed during the day if the battery died). As a resource, participants were given a detailed booklet with general information on the GPS unit, usage instructions that included pictures (e.g., how to turn on, how to recharge), and trouble-shooting tips. They were also encouraged to call the research office if questions arose. Also, to enhance their understanding of how the GPS would be used, they were shown example maps of GPS data and corresponding activity spaces at the baseline interview. Using a structured log, they were asked to record the daily start and end times of wearing the GPS, when the battery died (as needed), as well as any problems or unusual circumstances. During the study period, participants received at least one telephone call, during which they were asked if they had any questions or problems with the GPS.

The baseline and follow-up interviews in both studies included open-ended and close-ended questions related to GPS acceptability, barriers (wear-related concerns), and ease of use. Most items were the same in the ASMS and the DASES. However, based on what we learned in the ASMS, some items were added or slightly reworded in the DASES (see

Measures). All materials were available in English and Spanish, and the research teams included Spanish-speaking interviewers. Much of the demographic data were collected as part of the parent studies with which these pilot studies were affiliated.

Sample and Study-Specific Procedures

Activity Space Measurement Study (ASMS)—The ASMS was conducted in July-August 2007. All participants engaged in a pilot walking intervention (Walk Your Heart to Health) were invited to enroll in the ASMS.[30] All those who agreed to participate were randomly assigned to a 4-day or 7-day data collection period, in order to test for differences in activity space measures by length of time assigned to wear the GPS. In addition to the GPS, during the study period, participants were asked to complete a travel diary. Baseline and follow-up interviews were conducted following regularly scheduled walking group meetings, by the principal investigator (who is White) and walking intervention staff who were generally racially/ethnically-matched to study participants.

Detroit Activity Space Measurement Study (DASES)—The DASES was conducted in September 2008-April 2009. Participants were recruited from respondents to a 6-year follow-up, two-stage probability sample survey.[31] After completing the parent survey, respondents were read a brief description of the DASES, given a pamphlet with more detailed information about the study, and asked if they were interested in participating. The DASES research staff was provided names and contact information for those who expressed interest, and attempted to contact interested individuals via telephone. Once enrolled, participants were asked to wear a GPS for seven days. The baseline and follow-up interviews were conducted one-on-one by African American and Hispanic research staff who were current or former residents of the study communities. Those who enrolled during the first four months of the study completed the baseline and follow-up interviews at a site centrally located in relation to the three communities. To facilitate participation, for those who enrolled during the second four months of the study, research staff traveled to their homes to complete the interviews.

Measures

Acceptability—At baseline and follow-up, acceptability of the GPS was measured in both the ASMS and DASES with two items: *I feel comfortable with the research study tracking where I go using GPS* and *GPS makes it more interesting to participate in the study.* These items were rated on a 5-point scale, strongly disagree (1) to strongly agree (5). (At follow-up, these items were asked in past tense. For example: *I felt comfortable with the research study tracking where I went using GPS*.) At follow-up in the ASMS, we also asked the extent to which they preferred the GPS over the travel diary on a 5-point disagree-agree scale.

Barriers (Wear-Related Concerns)—We measured barriers, specifically wear-related concerns, on a 5-point disagree-agree scale. In both the ASMS and DASES, we included the following item at baseline and follow-up: *I worry about someone trying to steal the GPS*. In both the ASMS and DASES, a single item on comfort wearing the GPS was measured at follow-up. In the ASMS, this item asked if *The GPS was comfortable to wear* (reverse coded for analysis). To improve the clarity of the item to capture physical comfort, this item was changed in the DASES to *The GPS irritated my skin or was uncomfortable to wear*. Based on wear-related concerns raised in response to open-ended questions in the ASMS, we included three additional items in the DASES: *I am concerned that I will lose the GPS, I worry about my safety wearing the GPS,* and *I am concerned about how I will look wearing the GPS.* (At follow-up, these items were asked in past tense.)

Ease of Use—Ease of using the GPS was measured with three items. *GPS will be/was easy to use* was rated on a 5-point disagree-agree scale at baseline and follow-up. At follow-up, on a 5-point scale [very often (1), often (2), once in a while (3), almost never (4), never (5)], participants were asked how often they had problems with the GPS not working during the study and, among those who answered "very often" or "often," how often they were able to solve any problems with the GPS. For those who identified problems with the GPS, we asked for a description of the problems encountered.

Demographics and Prior Technology Use—We measured several demographic characteristics of the participants: age, gender (female, male), race/ethnicity (non-Hispanic African American, Hispanic, non-Hispanic White or Other), and four indicators of socioeconomic position (SEP): education (<high school degree, high school, some college, 4-year college degree), employment (currently employed, not employed), annual household income (<$10,000, $10,000–$30,000, ≥$30,000), and auto ownership (owns auto, does not own auto). (Henceforth, the racial/ethnic groups will be referred to as African American, Hispanic, and White.) We also measured prior experience with personal technologies including computers, handheld computers (DASES only), cellular telephones (DASES only), and portable GPS.

Analysis

We used descriptive statistics to describe the sample and prior experience with personal technologies for each pilot study, as well as the combined sample of both pilots. We compared the two pilot samples on demographic characteristics using Pearson chi-square tests. Due to skewed distributions, we dichotomized the GPS acceptability, wear-related concerns, and ease of use items for the analysis. Because of the relatively small sample sizes, we tested our research questions using the combined sample. We compared perceived GPS acceptability, wear-related concerns, and ease of use at baseline with these same measures at follow-up using the McNemar test. We tested for differences in GPS acceptability, wear-related concerns, and ease of use by participant demographics using binary logistic regression analysis. We identified participant-identified problems with GPS using content analysis of responses to open-ended questions.

Results

Sample

Figure 1 provides a flow diagram of participation by stage for the ASMS, DASES, and the two pilot studies combined, starting with eligibility (number of participants in the parent study) and concluding with completion of the follow-up interview. For the ASMS, all parent study participants expressed interest in the ASMS, and 86.7% (39 of 45) enrolled/completed a baseline interview. Of those who enrolled, all wore the GPS (as evidenced by recorded data) and completed the follow-up interview. For the DASES, 69.1% (320/463) of the parent study participants expressed interest. Those who expressed interest in the DASES were younger (mean age 48.1 vs. 54.9; p<0.001) and more likely to be currently employed (vs. not currently employed; p=0.020) (data not shown) than those who did not express interest. Of those who expressed interest, we enrolled 131 individuals. A lower percentage of men enrolled in the DASES (20.7%) as compared to the remaining parent study participants (32.7%) (p=0.007). Of those who enrolled, over 90% of participants wore the GPS (mean = 5.7 days) and completed a follow-up interview.

Table 1 shows the demographic characteristics and prior personal technology use of participants in the two pilot studies, as well as the combined sample. The ASMS and DASES samples differed significantly on gender ($X2$=5.89, p=0.015), income ($X2$=12.94,

p=0.002), and auto ownership (X2=4.44, p=0.035), with the DASES sample having proportionately fewer females, lower incomes, and lower auto ownership than the ASMS sample. Few participants (9.5%) had previously used a portable GPS.

Comparison of Baseline and Follow-up

Table 2 shows a comparison of reported GPS acceptability, wear-related concerns, and ease of use at baseline and follow-up for the combined sample. With respect to acceptability, participants were generally comfortable with their movement being tracked, with 82.1% and 86.8% agreeing or agreeing strongly that they felt comfortable with their movement being tracked using GPS at baseline and follow up, respectively. Furthermore, most participants reported that GPS made the study more interesting (72.4% at baseline; 78.9% at follow-up). In the ASMS, 64.1% of participants at follow-up strongly agreed or agreed that they preferred the GPS over the travel diary (not shown).

Most participants were not concerned about GPS wear-related issues (Table 2). Few participants reported concern that the GPS would be stolen (12.9% at baseline; 10.2% at follow-up). In the combined sample, 28.7% at follow-up reported that the GPS was uncomfortable to wear. In the DASES, less than 14% of participants at baseline or follow-up reported concerns about losing the GPS, their safety wearing the GPS, or their appearance wearing the GPS. (These questions were not asked in the ASMS.)

Participants generally found the GPS was easy to use (Table 2), and self-reports of ease of use increased significantly between baseline and follow up, from 70.6% at baseline to 87.6% at follow-up ($p<0.001$). Less than 13% of participants reported often or very often having problems with the GPS not working. Of those who reported problems, some (42.4%) indicated that they were often or very often able to fix problems.

Demographic Comparison

Table 3 shows relationships between participant demographic characteristics and perceptions of GPS acceptability, wear-related concerns, and ease of use, based on binary logistic regression analyses. With regard to GPS acceptability, White participants were significantly more likely to report being comfortable with their movement being tracked than African American participants, controlling for other demographics ($p<0.05$). Unadjusted cross-tabulations of race/ethnicity by this variable revealed that 96.4% and 92.7% of White and Hispanic participants, respectively, strongly agreed or agreed that they were comfortable with the study tracking their movement using GPS compared to 74.2% of African American participants. Age was negatively associated with comfort with GPS tracking ($p<0.05$). There were no other demographic differences in comfort with the GPS tracking. We found some demographic differences in whether individuals thought the GPS made the study more interesting. Those who thought that GPS made the study more interesting were younger ($p<0.05$) and more likely to be educated beyond high school (vs. less than a high school degree) ($p<0.05$) and have an annual household income <$10,000 (vs. >$30,000) ($p<0.05$).

With regard to wear-related concerns (Table 3), Hispanics were more likely than African Americans to report being worried about the GPS being stolen ($p<0.05$). Also, those who were currently employed were less likely to report concern about someone stealing the GPS as compared to those who were currently unemployed ($p<0.05$). There were no demographic differences at follow-up in perceived (physical) comfort with wearing the GPS.

The only statistically significant difference in perceived ease of use was that women were less likely than men to report that the GPS would be easy to use ($p<0.05$).

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For comparative purposes with the results presented here on the combined sample, Tables 2 and 3 are provided in an online Appendix for the DASES only sample.

Reported Problems Using GPS

In response to open-ended questions regarding any problems they encountered with the GPS, several technical and wear-related problems were identified. Technical problems were most commonly raised including the GPS battery dying before the end of the day and signal problems (e.g., not acquiring satellite signal or weak signal). Less frequently identified technical problems were a dim screen (which can occur with this GPS model by pressing a single button), difficulty navigating between screens, and not understanding how to use the GPS more generally (e.g., turn it on and off, recharge). Wear-related issues were also reported including the GPS was too bulky, got in the way of activities, and irritated skin. Rarely reported were that the GPS looked like a “tether” from the police or made them look like a “criminal” and that they didn’t wear the GPS where “security was an issue.”

Discussion

Overall, we found high receptivity to the use of GPS, with high ratings of GPS acceptability and ease of use and low levels of wear-related concerns or problems in these racially/ethnically diverse samples of low to moderate SEP adults. These perceptions were maintained, and in some cases even improved, after data collection.

Most participants reported that they were comfortable participating in a study in which their movements were tracked over time using the GPS. Information provided during the informed consent process on the ways we would protect their data with regard to storage and presentation, sharing of example maps, and racially/ethnically matched research staff from the study communities may have enhanced comfort levels. Still there were notable differences in comfort level by age and across racial and ethnic groups. In particular, older participants were less comfortable than younger participants, and three quarters of African American participants, compared to more than 90% of White and Hispanic participants, agreed or agreed strongly that they were comfortable with the GPS tracking. Concerns about GPS tracking may be higher among African Americans due to their experiences with discriminatory monitoring and profiling.[32, 33] It is possible that groups may vary in their comfort level according to other demographic variables not included in this analysis (e.g., documented versus undocumented immigration status). Researchers conducting further work in this area should consider potential concerns and vulnerabilities of study participants and address these to the extent possible through aspects of the study design. Education about privacy issues related to GPS and reassurance (e.g., detailed description of multilevel data security procedures) as part of the informed consent decision-making is important in GPS-enhanced studies.[34, 18] Stronger mechanisms to protect GPS data from forced disclosure, such as Certificates of Confidentiality issued by the National Institute of Health, may also be a tool that could allay some participants’ concerns about the GPS tracking in future studies.[18, 35]

Participants who were younger, with higher education, and lower incomes were more likely to report that the GPS made the study more interesting. The finding that use of GPS technology enhanced the appeal of the study for younger adults is consistent with research that has found that increasing age is associated with more negative attitudes and lower utilization of technology.[36–38] The possibility of differences according to SEP in access to GPS does not seem supported by our data, given that prior personal use was low across the sample. However, those of higher SEP tend to be the first adopters of innovations,[39] which might help to explain why those with the highest educational attainment found that the use of GPS made the study more interesting. Still this interest in innovations may be tempered by heightened privacy concerns among those of higher income,[40] which may explain why those with the highest income in our study were less likely to think that GPS made the study more interesting. Understanding characteristics of the study that may appeal to various demographic groups may provide important information to future researchers. There may be ways to emphasize the usefulness of GPS technology, an established predictor of technology adoption,[41] within future studies that may help to increase the appeal of GPS-enhanced studies to different groups.

With regard to acceptability, qualitative research may be beneficial to identify key pieces of information and strategies that might help to address the lower comfort levels with GPS among African Americans and older adults (and potentially other groups) and to make participation in GPS-enhanced studies more appealing to older, less educated, and higher income adults.

Overall, few participants reported wear-related concerns with regard to theft, loss, safety, or appearance. More explicit, but careful (as to not raise concerns unnecessarily), instructions at baseline could help to address any concerns, which were significantly higher with regard to theft among Hispanic participants and those not currently employed. For example, participants could be encouraged to avoid “showing off” their GPS and to preemptively remove the GPS if entering situations in which security is a concern. Living conditions (e.g., community crime rates) may make these concerns more likely for some groups. The most frequently identified wear-related concerns for the wrist-mounted GPS were physical discomfort and appearance. We selected the wrist-mounted Foretrex 201 because at the time of these studies it had documented reliability,[22] good battery performance, and was a low-cost commercially available GPS model. Newer models that are smaller and less conspicuous (e.g., can be worn on the waist and under clothing) may address these wear-related issues.

Furthermore, participants generally found the GPS easy to use, with even more participants agreeing it was easy at follow-up than baseline. Women were less likely than men to report that the GPS would be easy to use. Because our sample is biased with respect to gender (e.g., women were more likely to participate in the DASES than men), our interpretation of this finding is cautious. Prior studies have found that women have lower self-confidence in their ability to use technologies, even though their performance is similar to men.[36, 42, 43] If our finding is confirmed by future research, studies may benefit from pilot-testing of training approaches and materials to ensure they bolster women’s self-efficacy and skills in the use of GPS.

Overall, the most commonly identified problems were related to GPS battery performance and signal acquisition and loss. Again newer GPS models, specifically GPS data-loggers, have longer battery lives, better GPS technology, and require much less attention from participants besides recharging. This may facilitate their use in research studies involving participants with varying degrees of familiarity and comfort with personal technologies. A potential downside is that data-loggers do not allow participants to check the satellite signal; therefore, participants cannot monitor problems with signal detection.

Limitations and Strengths

The study has limitations. First, the sample was limited in that it was relatively small (though larger than the majority of GPS-enhanced studies to date),[44] from a single city, and consisted of individuals who were already engaged in research and who had little prior experience using GPS and other personal technologies (besides cellular telephones). While these patterns of lower technology use are fairly typical of lower SEP groups,[45] our findings may not apply to those with more experience or familiarity with GPS and other personal technologies. Findings on acceptability of using GPS may differ depending on the context, with acceptability being lower, for example, among Hispanics or immigrant groups in areas where tensions around immigration are higher. The relatively small samples also contributed to wide confidence intervals for the demographic comparisons in regression analyses, and the possibility that findings reported here are conservative. Second, we combined the samples from two pilots in order to maximize statistical power for testing our study objectives. Still, results based on the DASES sample only were generally consistent with those presented here (see online Appendix); thus, enhancing confidence in our pooled sample results. Third, as described above, use of the Foretrex 201 in our pilot studies may have presented additional challenges for participants as compared with newer GPS models and data-loggers now available. Despite these limitations, this study provides important preliminary evidence supporting the feasibility, based on participants' perceived acceptability, barriers, and ease of use, of utilizing GPS with racially/ethnically diverse urban adults of low to moderate SEP. Its strengths include the diverse sample, detailed information on participants' perceptions of GPS at baseline and follow up, and comparison of GPS perceptions by individual demographics.

Conclusions

Understanding of geographic environmental influences on body weight and related behaviors, including physical activity, has grown dramatically over the past decade. Most research to date has focused solely on the environment immediately around where individuals live (residential neighborhood), defined as a surrounding administrative unit (e.g., census tract, ZIP code) or buffer (e.g., 0.5 mile Euclidean or street network buffer), rather than the where they spend time (e.g., activity space).[46–51] GPS allows more comprehensive and accurate measurement of the environment to which individuals are exposed through day-to-day activities and where they are (and are not) physically active. As such, GPS has the potential to advance research on the environment and obesity risk.[44] We found that the use of GPS was feasible with participants in two racially/ethnically diverse, lower SEP samples, supporting the feasibility of conducting more extensive research with this technology in similar populations at high risk of obesity and related chronic conditions. The findings reported here suggest several steps that can be taken by researchers to increase engagement of similar groups in future GPS-enhanced research, increasing the promise of this methodology in efforts to identify environmental contributions to obesity and related health outcomes.

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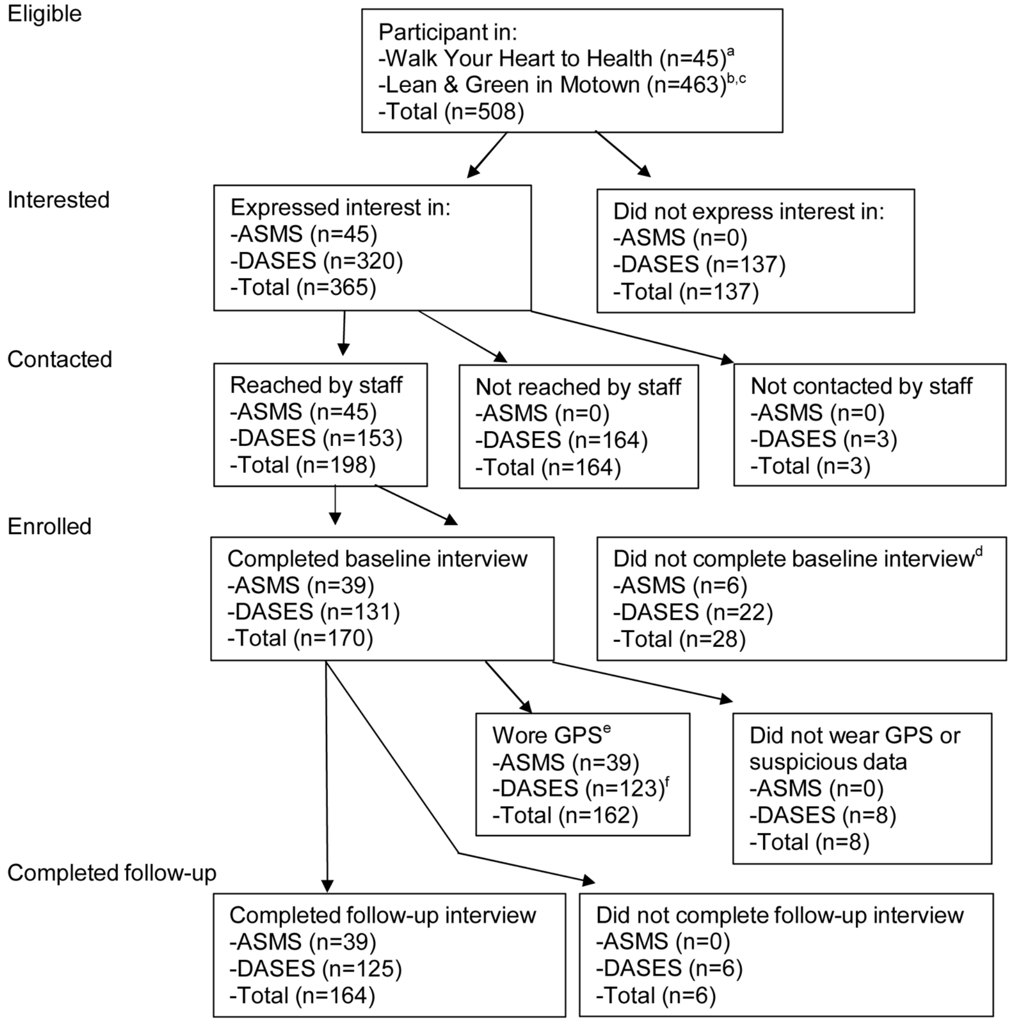

Figure 1.

Depiction of participation by stage for participants in the Activity Space Measurement Study (ASMS), Detroit Activity Space Environment Study (DASES), and both pilot studies combined ("total")

[a]Participants in the Walk Your Heart to Health study were eligible for the Activity Space Measurement Study (ASMS)

[b]Participants in the Lean & Green in Motown study were eligible for the Detroit Activity Space Environment Study (DASES)

[c]Only 457 Lean & Green in Motown respondents had completed the survey when the DASES stopped all recruitment due to lack of funds.

[d]Scheduling conflicts with the pre-determined interview dates were cites as reasons for not enrolling in the study for those in the ASMS. Those who did not complete the baseline interview in the DASES were refusals.

[e]As evidenced by recorded data, all participants wore the GPS. In the ASMS, 88.9% of the 4-day data collection group wore the GPS for four days; 85.7% of the 7-day data collection group wore the GPS for 7 days.

[f] Includes three participants for which we were unable to process the GPS data due to staff errors

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Table 1

Descriptive statistics of participant demographics and prior experience with personal technologies for ASMS, DASES, and combined sample

	Activity Space Measurement Study (ASMS; n=39)[a]		Detroit Activity Space Environments Study (DASES; n=131)[b]		Combined (n=170)[c]	
	%	n	%	n	%	n
Demographics						
Age, years						
<45	41.0	16	38.9	51	39.4	67
45–64	46.2	18	51.9	68	50.6	86
>64	12.8	5	9.2	12	10.0	17
Female	92.3	36	74.0	97	78.2	133
Race/ethnicity						
Non-Hispanic African American	66.7	26	55.0	72	57.6	98
Hispanic	25.6	10	24.4	32[d]	24.7	42
Non-Hispanic White/Other	7.7	3	27.6	27[e]	17.6	30
Education						
Less than high school	25.6	10	37.4	49	34.7	59
High school degree	10.3	4	18.3	24	16.5	28
Some college	41.0	16	31.3	41	33.5	57
4-year college degree	23.1	9	13.0	17	15.3	26
Currently employed	41.0	16	34.4	45	36.5	61
Annual household income						
<$10,000	24.2	8	37.8	45	34.9	53
$10,000–$30,000	30.3	10	46.2	55	42.8	65
>$30,000	45.5	15	16.0	19	22.4	34
Owns automobile	81.1	30	62.6	82	66.7	112
Part of original 2002–2003 sample	--	--	39.7	52	--	--
Area of city						
Eastside	33.3	13	25.2	33	27.1	46
Southwest	33.3	13	53.4	70	48.8	83

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	Activity Space Measurement Study (ASMS; n=39)[a]		Detroit Activity Space Environments Study (DASES; n=131)[b]		Combined (n=170)[c]	
	%	n	%	n	%	n
Northwest	33.3	13	21.4	28	24.1	41
Prior experience with personal technologies						
Had previously used a portable global positioning system	2.6	1	12.2	16	9.5	16
Used computer almost every day or everyday	48.6	18	29.8	39	33.9	57
Had cellular telephone	--	--	80.9	106	--	--
Had handheld computer	--	--	3.1	4	--	--

-- Not applicable or not asked

[a] In ASMS, missing data: n=3 for employment status, n=6 for annual household income, n=2 for auto ownership, n=2 for computer use, and n=1 for GPS use

[b] In DASES, 12 missing data for annual household income

[c] Chi-square tests revealed that ASMS and DASES samples differed significantly on gender (X^2=5.89, p=0.015), income (X^2=12.94, p=0.002), and auto ownership (X^2=4.44, p=0.035).

[d] 75.0% of the Hispanic participants were first generation immigrants.

[e] Of those who were non-Hispanic White/Other, 92.6% (n=25) self-identified as non-Hispanic White and 7.4% (n=2) as Other (American Indian).

Table 2

Comparison of perceptions of GPS acceptability, barriers (wear-related concerns), and ease of use at baseline and follow-up (Combined sample)

	n[a]	Baseline %	Follow-up %	*p*-value
Acceptability				
Comfortable movement tracked[b]	151	82.1	86.8	0.349
Study more interesting because GPS[b]	152	72.4	78.9	0.174
Barriers(wear-related concerns)[d]				
Worried GPS will be stolen[b]	147	12.9	10.2	0.344
GPS uncomfortable to wear[b, e]	157	--	28.7	--
Ease of use				
GPS easy to use[b]	153	70.6	87.6	<0.001
Problems with GPS not working[c]	159	--	12.6	--
If so, able to fix problems[c]	19	--	42.4	

[a]Sample size based on those with complete (no missing) data at baseline or follow-up

[b]Agreed or strongly agreed

[c]Often or very often

[--]Not assessed or not applicable

[d]DASES added three additional items on wear-related concerns. The percentage who agreed or strongly agreed at baseline and follow-up, respectively, were the following: concerned will lose GPS (10.4%, 13.9%), worried about safety wearing GPS (13.2%, 9.6%), and concerned about appearance wearing GPS (12.1%, 13.8%).

[e]In ASMS, the item was *GPS was comfortable to wear* (reverse-coded). In DASES, the item was *GPS irritated my skin or was uncomfortable to wear.*

Table 3

Binary logistic regression results for relationships between perceptions of GPS at baseline[a] and participant demographic characteristics, Combined sample (n=154–160)

	Acceptability				Barriers (Wear-Related Concerns)				Ease of Use	
	Comfortable tracking movement using GPS		GPS makes the study more interesting		Worried GPS stolen		GPS uncomfortable to wear		GPS easy to use	
	O.R.	95% C.I.	O.R.	95% C.I.	O.R.	95% C.I.	O.R.	95% C.I.	O.R.	95% C.I.
Age	0.97*	(0.92, 1.00)	0.96*	(0.93, 0.99)	0.99	(0.95, 1.03)	0.99	(0.97, 1.02)	0.98	(0.95, 1.01)
Gender										
Male	1.00		1.00		1.00		1.00		1.00	
Female	0.60	(0.18, 2.03)	0.36	(0.12, 1.02)	0.43	(0.13, 1.44)	2.37	(0.80, 6.99)	0.28*	(0.10, 0.81)
Race/ethnicity										
African American	1.00		1.00		1.00		1.00		1.00	
Hispanic	3.70	(0.88, 15.63)	1.00	(0.35, 2.88)	6.71*	(1.81, 24.81)	1.10	(0.38, 3.17)	1.15	(0.43, 3.10)
White/Other	9.07*	(1.10, 75.06)	0.62	(0.21, 1.88)	0.43	(0.08, 2.29)	1.56	(0.58, 4.17)	0.50	(0.18, 1.39)
Education										
< High school degree	1.00		1.00		1.00		1.00		1.00	
High school degree	2.01	(0.62, 6.54)	1.69	(0.64, 4.43)	1.17	(0.36, 3.78)	2.04	(0.78, 5.34)	1.67	(0.67, 4.16)
>High school degree	4.98	(0.84, 29.59)	5.04*	(1.18, 21.47)	1.47	(0.26, 8.24)	1.97	(0.55, 7.08)	3.72	(0.99, 13.92)
Employment status										
Not currently employed	1.00		1.00		1.00		1.00		1.00	
Currently employed	0.65	(0.23, 1.83)	0.79	(0.33, 1.89)	0.07*	(0.01, 0.38)	0.50	(0.20, 1.23)	0.50	(0.22, 1.16)
Annual household income[b]										
<$10,000	1.00		1.00		1.00		1.00		1.00	
$10,000–$30,000	0.86	(0.24, 3.04)	0.50	(0.18, 1.42)	0.47	(0.14, 1.59)	0.96	(0.39, 2.41)	0.79	(0.32, 1.98)
>$30,000	0.25	(0.06, 1.13)	0.16*	(0.04, 0.57)	1.42	(0.29, 7.06)	1.26	(0.39, 4.07)	0.62	(0.19, 2.03)
Auto ownership										
Does not own auto	1.00		1.00		1.00		1.00		1.00	
Owns automobile	1.07	(0.34, 3.34)	0.73	(0.29, 1.83)	1.51	(0.51, 4.50)	0.89	(0.38, 2.09)	0.56	(0.24, 1.32)

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O.R. = Odds ratio C.I. = Confidence interval

[*] $p<0.05$

[a] All five variables are from baseline except for GPS comfortable to wear, which was only assessed at follow-up. We presented the baseline results because any changes in perceptions between baseline and follow-up tended to be positive; therefore, the baseline results are more conservative. Furthermore, the baseline results are especially informative with regard to participants' decisions to enroll in the study.

[b] We included the missing category for annual household income (n=18); results not shown.