Smartphone ownership and perspectives on health apps among a vulnerable population in East Harlem, New York

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Background: Individuals from low-income and racial/ethnic minority backgrounds have traditionally had less access to mobile health (mHealth) technologies, but there is evidence that this gap has been rapidly narrowing. Given the increase in access to mobile technologies recently seen in vulnerable populations, mHealth has been championed as a strategy for improving population health and reducing health disparities. However, members of low-income and racial/ethnic minority populations have had a limited role in the development and implementation of mHealth interventions designed to impact them.

Methods: We used community-based participatory research (CBPR), a research approach that is frequently employed to help reach communities that are disproportionately affected by illness but are difficult to engage. Our community-academic collaboration, the East Harlem Partnership for Diabetes Prevention, sought to create a mobile technology platform that would allow adults in East Harlem, New York to improve their own health and promote the health of the broader community. As a first step, we developed and conducted a survey of community residents to better understand access to, usage of, and attitudes towards mobile technologies among diverse, low-income adults. We administered the cross-sectional survey to a convenience sample of adults who utilized a variety of community-based organizations in East Harlem. We examined frequencies for each survey item and then used chi-square tests (or Fisher's exact tests) and multivariate logistic regression to evaluate relationships between these outcomes and sociodemographic factors.

Results: We approached 154 people, of whom 104 (68%) agreed to participate. The majority of respondents were of Black and/or Hispanic/Latino descent with a mean age of 37 years. Our sample displayed a high percentage of smartphone ownership (82% of the participants reported that they owned a cell phone, and 88% of owners reported that their cell phone was a smartphone). We found lower rates of ownership among individuals who were older, self-identified as Latino, insured by Medicare, and had a household income of less than $30,000 per year. Multivariate logistic regression showed that after adjusting for age, gender and race, those with at least a high school education were seven times more likely to use health apps than those with less than a high school education (OR 6.8, 95% CI: 1.7–27.1). Participants expressed interest in health promoting apps that provide interactive, individualized diet, exercise and weight loss tools and offer information about local health resources and events.

Conclusions: Despite some notable disparities, our study results suggest that the digital divide is narrowing in the East Harlem community with relatively high rates of smartphone ownership and use, even among individuals from low-income, low education backgrounds and those without health insurance. Based on study results, our partnership developed an app supporting healthy lifestyle and diabetes prevention tailored to the East Harlem community.

Keywords: Mobile health (mHealth); mobile apps; type 2 diabetes; community-based participatory research (CBPR)

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Introduction

The term "digital divide" has been used to describe the gap in access to internet services and mobile technologies across different sociodemographic groups. While individuals from low-income and racial/ethnic minority backgrounds have traditionally been on the access-poor side of the divide, there is growing evidence that the gap is narrowing rapidly. In the United States (US), 94% of African-Americans, 98% of Hispanics/Latinos, and 92% of those who earn less than $30,000/year reported that they own a cell phone in 2016 (1).

Such widespread use of mobile technologies has created a growing platform for mobile health (mHealth), the provision of health services and health information via short message service (SMS)/text messaging, mobile internet, and mobile applications (2-6). Given the increase in access to mobile technologies recently seen in low-income and racial/ethnic minority populations, mHealth has been championed as a strategy for improving population health and reducing health disparities. Several studies have been conducted on the use of mHealth to support individuals with chronic diseases such as diabetes, cardiovascular disease, and for smoking cessation (7-11). Results from many of these studies show positive outcomes, particularly with regard to lifestyle and behavioral changes. However, most studies to date examining mHealth do not include members of specific vulnerable populations. Thus, critical information to optimize and culturally tailor the development and implementation of mHealth interventions is not yet available for the benefit of low-income and racial/ethnic minority populations. There is also little evidence that members of minority communities have an active and substantive role in ensuring the rapidly growing field of mHealth will be relevant to and useful for diverse stakeholders.

Community-based participatory research (CBPR) is a research approach that is frequently employed to help reach communities that are disproportionately affected by illness but are difficult to engage (12). East Harlem, also known as El Barrio, is a primarily low-income, Black and Latino neighborhood in Northeastern Manhattan. East Harlem has one of the highest rates of obesity (33% compared to 16% in Manhattan as a whole) and diabetes (13% compared to 7% in Manhattan as a whole) in New York City (13). The East Harlem Partnership for Diabetes Prevention is a 10-year old community-academic collaboration (14). The partnership developed a peer-led diabetes prevention program [Project Help Educate to Eliminate Diabetes (HEED)]. (15) Because HEED led to weight loss and slowing the trajectory of rising glucoses, the partnership, community stakeholders and HEED participants recommended that we create a mobile technology platform that would allow adults in East Harlem to improve their own health and promote the health of the broader community. As a first step in developing this platform, we utilized CBPR to develop, conduct and analyze a cross-sectional survey of community residents to better understand access to, usage of, and attitudes towards mobile technologies among diverse, low-income adults.

Methods

Members of the Community Action Board (Board) of the East Harlem Partnership for Diabetes Prevention were involved in all stages of survey design, data collection, and analysis. Our survey development team, including Board members (patients, advocates and clinicians) and experts in social media and app development, developed a 26-item survey including both published and newly created items. We measured technology use by incorporating items from the Pew Research Center surveys (16,17) assessing cellphone/smartphone ownership, access to and usage of the internet, use of social media websites and applications, use of email/text messaging, attitudes towards mobile technology, and internet and app use to obtain health information and track personal health information. The team developed new questions related to a diabetes prevention app, potential app functions (e.g., getting tips on exercise and weight loss, finding out about local health events, and communicating with others in the community) and use of social media for community change. The survey also included questions related to age, gender, race/ethnicity, income, education, employment, health insurance coverage, and health status.

We administered the cross-sectional survey to a convenience sample of adults who utilized community-based organizations in East Harlem. We selected adults from a variety of organizations that provide services to different segments of the community to increase the representativeness of the sample. Organizations included a food pantry, school, church, social service delivery sites and neighborhood health centers. Adults were eligible to participate if they utilized services at one of these community-based organizations and spoke English or Spanish.

Board members at these community organizations described the study to potential participants, and trained staff then read a verbal consent form to those who agreed to participate. Participants completed a 5-minute written or verbal survey and received a $10 store gift card in appreciation of their time. The study was approved by a local Institutional Review Board.

The main outcomes of interest were access to, usage of, and attitudes towards mobile technologies. We calculated frequency data for each survey item. We also conducted chi-square tests or Fisher's exact tests to evaluate relationships between these outcomes and sociodemographic factors, and multivariate logistic regression analyses for our main outcomes (cell phone ownership and use of health related mobile apps). All analyses were performed using the statistical software package SAS 9.4 (SAS Institute Inc., Cary, North Carolina, USA).

Results

We approached 154 people, of whom 104 (68%) agreed to participate. The majority of respondents were female and of Hispanic/Latino descent with a mean age of 37 years. As 94% of respondents were Black or Latino, we collapsed all other respondents in the category "other." Of those who answered the question about income (one third did not answer), most reported a household income of <$30,000 per year. In addition, 40% had not graduated high school and 37% were uninsured (*Table 1*).

Cell phone ownership, usage and attitudes

Fully 82% of the participants reported that they owned a cell phone, and 88% of owners reported that their cell phone was a smartphone. Those who self-identified as Latino had lower cell phone ownership than those of other races or ethnicities (P=0.03) (*Table 1*). Medicare-insured participants had the lowest rate of ownership followed by those who were either uninsured or Medicaid-insured, while 100% of those with private insurance reported that they owned a cell phone (P=0.01). Among those owning a cell phone, Medicare-insured participants were least likely and Medicaid-insured participants were most likely to report that their cell phone was a smartphone. Individuals with a household income of <$30,000 per year had lower rates of cell phone ownership than those who earned ≥$30,000 per year (P=0.094), but among cell phone owners, smartphone ownership did not vary significantly based on income. We further examined whether there were any differences in ownership among the low income group (annual income less than $5,000, $5000–15,000, and $15,000–30,000) and did not find any significant differences. Rates of cell phone and smartphone ownership also decreased with age, ranging from about 90% among those 16–29 years to only 33% among those 65 years or older. Multivariate logistic regression showed that after adjusting for gender, education level, and race, older people were less likely to own a cell phone (OR 0.95, 95% CI: 0.90–0.99) and less likely to report that their cell phone was a smart phone (OR 0.92, 95% CI: 0.85–0.99). The other predictors (gender, education, and race) were not significantly associated with cell phone or smart phone ownership in these regression models.

Participants reported using their phone for sending/receiving email (49% reported use "many times a day"), sending or receiving text messages (67% reported use "many times a day"), accessing the internet (60% reported use "many times a day"), using social media apps (58% reported use at least once a day), and looking for health or medical information online (58% reported use at least once a week). Only 26% of participants with smartphones reported that they worried "a moderate amount" or "a great deal" about going over their data plan. However, nearly 70% reported that they were "extremely or moderately worried" about privacy while using the internet. Of those owning a smartphone, only 27% reported that they had ever paid for an app or game.

Participants who owned a smartphone were asked about use of mobile apps to track or manage their health, and 39% reported use of some type of health app. Of those reporting use of these apps, 78% used exercise/fitness apps, 33% used apps to track diet, 22% used apps to track weight, 19% used apps to track menstrual cycles, and much fewer used apps related to blood pressure (7%), diabetes (11%), medication management (4%), pregnancy (7%), mood (4%) and sleep (<1%).

Table 1 Cell phone/smart phone ownership and use of health apps based on demographics

Variables	Overall (N=103) [%]	Own cell phone		Own a smart phone‡		Use health apps§	
		n=84 [82] (%)	P	n=70 [88] (%)	P	n=27 [39] (%)	P
Age†			0.098		0.097		0.83
18–29	30 [34]	27 [90]		24 [92]		9 [38]	
30–49	42 [47]	35 [83]		32 [91]		14 [44]	
50–64	14 [16]	11 [79]		8 [80]		4 [50]	
≥65	3 [3]	1 [33]		1 [33]		0	
Gender†			0.54		1.00		0.58
Female	68 [74]	54 [79]		47 [89]		21 [45]	
Male	24 [26]	21 [88]		17 [89]		6 [35]	
Race/ethnicity†			0.031		0.84		0.85
Hispanic/Latino	67 [67]	51 [76]		44 [88]		17 [39]	
Non-Hispanic Black	27 [27]	26 [96]		21 [84]		43 [43]	
Other	6 [6]	6 [100]		4 [100]		1 [25]	
Income†			0.094		0.24		0.77
< $30,000/year	49 [71]	41 [84]		31 [82]		13 [42]	
≥ $30,000/year	20 [29]	20 [100]		19 [95]		9 [47]	
Education†			0.17		1.00		0.0088
< High school	39 [40]	30 [77]		24 [89]		4 [17]	
≥ High school	59 [60]	52 [88]		45[88]		23 [51]	
Insurance†			0.011		0.073		0.80
Medicare	7 [7]	4 [57]		2 [50]		1 [50]	
Medicaid	31 [31]	25 [81]		24 [96]		10 [42]	
Private	25 [25]	25 [100]		18 [82]		8 [44]	
Uninsured	37 [37]	29 [78]		25 [89]		8 [32]	

†, number of participants with missing information for the following variables: age [14], gender [11], race/ethnicity [3], income [34], education [5], insurance [3]; ‡, only those who reported owning a cell phone were asked if their cell phone is a smart phone; §, only those who reported owning a smart phone were asked about health apps.

There was no association between use of health apps and generally keeping track of weight, diet, or exercise or between use of health apps and generally keeping track of specific health information (e.g., blood pressure, blood sugar, sleep, headaches). Most (54%) of those who did not use health related apps cited not knowing about them as the reason. There was no difference in use of health apps based on gender, age, race/ethnicity, income or insurance status (*Table 1*). However, those with a high school degree or higher were more likely to use these apps than those who did not graduate from high school (51% *vs.* 17%, P=0.01). Multivariate logistic regression showed that after adjusting for age, gender and race, those with at least a high school education were seven times more likely to use health apps than those with less than a high school education (OR 6.8, 95% CI: 1.7–27.1).

Interest in potential app functions

While relatively few respondents used health apps, over half stated that they were very or extremely interested in apps that offered tips on exercise and weight loss, exercise

Table 2 Reported interest in app functions

Function	Not/a little interested (%)	Somewhat interested (%)	Very/extremely interested (%)
Get tips on exercise and weight loss	28	18	55
Track exercise and diet	31	19	51
Join online chat rooms and forums about health	58	10	32
Find out about local health events	30	16	54
Communicate with your doctor's office	31	22	47

and diet tracking, and information on local health related events. In addition, almost half were very or extremely interested in an app that would allow them to communicate with their doctor's office (*Table 2*).

Discussion

Low-income and racial/ethnic minority populations are disproportionately affected by chronic disease, have less access to quality care, and experience worse health outcomes (18). Focusing in on the neighborhood of East Harlem, our community-academic partnership aimed to evaluate the usage of and attitudes towards mobile technologies in this population in order to inform the development of a new mobile platform for dissemination of diabetes prevention information. Our sample displayed a high percentage of cellphone and smartphone ownership, with some use of apps to track and manage health. Participants expressed interest in health promoting apps that provide interactive, individualized diet, exercise and weight loss tools and offer information about local health resources and events.

There has been a dramatic increase in mobile phone ownership in the US in the past ten years. The overall rate of cell phone ownership in our sample (82%) was somewhat lower than that reported in a recent survey of the general US population (95%) (1). However, smartphone ownership as a proportion of total cell phone ownership in our sample was higher (88%) than the national average (81%). This may be due to the fact that the majority of our sample included individuals from low-income and racial/ethnic minority backgrounds who may be more likely to be smartphone dependent because they rely on smartphones as their sole access point to the internet (1,19,20).

According to results from the most recent Pew Research Center report, there were no major differences in cell phone ownership based on gender, race/ethnicity, education level, income or community type (urban, suburban or rural), with reported rates of ownership >90% in all subgroups (1). We also did not find significant differences in ownership based on gender or education level. However, we did find notable differences in cell phone ownership based on race/ethnicity, with similar rates of cell phone ownership among Blacks (96% in East Harlem *vs.* 94% nationwide), but lower among Latinos (76% in East Harlem *vs.* 98% nationwide). This may be explained by differences between East Harlem Latinos and Latinos nationally in terms of income, language/literacy barriers, or how recently they immigrated to the United States (21,22). For example, Hispanics are the most common racial/ethnic group living below the poverty line in East Harlem, almost 40% of East Harlem residents are native Spanish speakers, and the community has more recent immigrants than in the US as a whole. All of these factors could impact access to cell phones/smart phones. We also found a wider income disparity in cell phone ownership than has been reported: comparing those earning less than $30,000 to those earning more than $30,000 per year, in East Harlem ownership was 84% *vs.* 100% while nationally it was 92% *vs.* 97%. While there were no differences in overall cell phone ownership among the low income group, we do not have information about the specific type of cell phones participants own or details about their plan such as the amount of data they have per month. It is important to note that despite some disparities, low-income individuals still have high levels of ownership. Similar to other studies (1), we found that after adjusting for gender, education level, and race, older people were less likely to own a cell phone and less likely to report that their cell phone was a smart phone. However, we cannot generalize about the impact of age on cell phone ownership in our sample because there were only three people who were older than 65. In terms of insurance, we also found that Medicare recipients had lower rates of ownership than individuals with private insurance, Medicaid, or even the uninsured. As only one out of the seven participants with

Medicare in our sample was older than 65, this finding seems to indicate that lower cell phone ownership among Medicare recipients may be explained by a combination of older age and disability.

The increase in smartphone ownership has created a growing market for mHealth applications. Our sample reflects this phenomenon as 39% of participants reported that they use apps to track or manage their health *vs.* 19% nationally (23). In our study, individuals with a high school degree or higher were more likely to report use of health apps than those who did not graduate from high school, even after adjusting for age, gender and race/ethnicity. This finding may be attributed to factors such as income or health literacy (24). However, further research is needed to examine whether this applies to specific vulnerable populations and why some groups may be more prone to using these tools than others.

With regards to specific uses or functions of health apps, there seems to be common ground in the literature. Previous studies have found that 62% of smartphone owners have used their phone in the last year to look up information about a health condition, and over half of mobile phone users have downloaded a mHealth related app, with fitness and nutrition apps being the most popular (25). Although current use of health apps was somewhat lower in our population, almost 70% of our respondents said that they would be at least somewhat interested in an app which allows them to track exercise and diet behaviors. Most participants also expressed interest in apps that would provide tips on exercise and weight loss and apps that would allow them to learn about local health related events and share information with others in their community.

mHealth apps can have a large impact on members of a community if time is taken to ask users what functions would be most helpful to them. It is specifically important to take time to understand the needs of underserved communities as they may face barriers that others might not. Based on results of this study, our community-academic partnership decided to develop an app supporting healthy lifestyle and diabetes prevention tailored to the East Harlem community. Users are able to use the app to track their nutrition and exercise behaviors, find out about health events in the community, identify local places of wellness (such as restaurants with healthy menu options and fun parks), and organize together for better access to healthy foods and safe spaces for exercise. Engaging community partners in app development is also a way to build capacity for a wider diversity of stakeholders to contribute to the field of mHealth.

Understanding mHealth use among underserved populations is complex because it is still a relatively new practice, and some members of these communities may have limited exposure or experience with these tools. As a result, the methods utilized have some limitations. Our sample size was small, and most participants (73%) were women. Also, our data was obtained through a convenience sample, which does not fully represent the population and limits our generalizability. However, our study also has some notable strengths, including the use of a CBPR approach and diversity of the study population based on age, gender, race/ethnicity, insurance status, income, and education.

Despite some notable disparities across sociodemographic groups, our study results suggest that the digital divide is narrowing in the East Harlem community with relatively high rates of cell phone and smartphone ownership and use, even among individuals from low-income, low education backgrounds and those who do not have health insurance. Thus there is great potential for mHealth applications to address health disparities by increasing access to health information and services for underserved populations. It is critical to have an understanding of a community's resources, needs, and interests in order to develop mHealth tools to accommodate the diversity found within underserved populations. Given such high use of mobile technologies and interest in interactive and individualized health promoting apps in our sample, a mobile technology platform to disseminate diabetes prevention strategies might be useful to those in East Harlem, if appropriately customized to the community's needs.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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