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Health information seeking of low socioeconomic status Hispanic adults using smartphones

Henna Kim and Yan Zhang
The University of Texas at Austin, Austin, Texas, USA

Abstract

Purpose – Smartphones have great potential to bridge the digital divide that low-socioeconomic status (SES) Hispanics have been experiencing. However, little is known about this group's use of smartphones for health information. The purpose of this paper is to fill the gap by exploring the context in which smartphones were used for health information.

Design/methodology/approach – The authors interviewed 20 low-SES Hispanic participants using the semi-structured interview method. Participants had not obtained college degrees and had annual incomes less than $30,000, but had used their smartphones for health information. The interviews were transcribed and analyzed using the qualitative content analysis method.

Findings – Being economical was an important reason for low-SES Hispanic users to use smartphones for health information. The users relied heavily on public Wi-Fi to access the internet. They searched a wide range of health topics, mostly using the mobile web rather than apps. They lacked knowledge and skills to effectively using apps, evaluating the quality of health information, and comprehend information.

Research limitations/implications – Having access to smartphones alone does not help bridge the digital gap for low-SES Hispanics. Interventions need to consider improving these users' smartphone literacy and health literacy, as well as improving their access to Wi-Fi services and to more quality content in Spanish.

Originality/value – Prior studies speculated that smartphones could be a means to bridge digital divide experienced by the Hispanic ethnic group. This study provided empirical knowledge about how smartphones are used by these users for health information, and shed light on the design of future informational interventions.

Keywords Smartphones, Health information seeking, Hispanics, mHealth, Mobile context

Paper type Research paper

1. Introduction

The Hispanic population, the largest and growing minority in the USA (US Census Bureau, 2012), is an underserved group in terms of access to healthcare resources. They have lower health insurance coverage rates (US Census Bureau, 2012), lower screening rates (Balluz *et al.*, 2004; Vega *et al.*, 2009), and fewer referrals for necessary medical procedures (Vega *et al.*, 2009), compared to other ethnic groups. They also suffered disparities in information access, facing significant challenges in accessing the internet for reasons ranging from finance, geographical location, language, culture, and computer literacy (López *et al.*, 2011; Lorence *et al.*, 2006). The lack of access to the internet, and subsequently online health information could lead to unequal opportunities to benefit

from available health information, and result in more difficulties in patient-provider communication, decision making, and self-care and self-management (Muha *et al.*, 1998; Stevens *et al.*, 1997). These disadvantages can further contribute to enlarge health disparities for this group, particularly those with an annual income less than $30,000 (Lorence *et al.*, 2006).

Smartphones are another tool that show great potential to bridge the information access gap (Free *et al.*, 2013). In recent years, smartphones have been quickly adopted by users. As of now, 64 percent of American adults own a smartphone of which 62 percent have used their phones to look up health information, making it the most popular use of smartphones (Smith, 2015). Moreover, a recent study showed that Hispanics have the highest smartphone ownership among ethnic groups, and are more likely to look up health information using their phones than blacks and whites (Fox and Duggan, 2013). However, little is known about the users, particularly those of low-socioeconomic status (SES), health information seeking behavior using smartphones. The exploratory study intends to fill this gap by investigating three factors that help shape this behavior: the characteristics of smartphones, the usage context, and barriers that these users face in using smartphones for health information (Courtright, 2007; Johnson, 1997; Wilson, 2006). The results will inform the design of smartphone-based interventions for promoting health behavior, and further contribute to narrowing inequality in information access and reducing health disparities for low-SES Hispanic users.

2. Literature review
Corresponding to our research goals, we will review the literature in three areas: the characteristics of smartphones that affect their adoption, their usage context, and barriers to use then for health information.

2.1 Characteristics of smartphones that affect its adoption
The adoption of smartphones into one's life is a complicated decision influenced by a number of individual characteristics. Studies suggested that male, younger adults in their 20s and 30s, and those with high levels of household income and educational attainment are more likely to own a smartphone (Lopez *et al.*, 2013). Social influence factors, such as affiliation and perceived popularity of a new technology, also have an impact. For example, some users, particularly young adults often determine to own a smartphone based on expected popularity gained by interacting with others using the phone rather than based on their actual needs (Kim *et al.*, 2014).

The adoption of smartphones is also impacted by the characteristics of the technology itself. Kang *et al.* (2011) identified five main attributes of smartphones contributing to its adoption: wireless internet (and ubiquity), design of the phone, multimedia functions, available applications, and customer service. They suggested that the design of the phone affects the perceived usefulness, while the other four attributes affect both perceived usefulness and perceived ease-of-use. Moreover, they demonstrated that users' intention to adopt smartphones is significantly affected only by perceived usefulness. Several other studies showed that fun and enjoyment mediate the effect of usefulness on the use of smartphones (Chtourou and Souiden, 2010; Song and Han, 2009).

2.2 Context for information seeking using mobile devices
Context shapes and defines information seeking behavior (Courtright, 2007). Understanding context is particularly important for understanding the use of smartphones, as the

technology is ubiquitous and its use is almost entirely dependent on context; thus being context-aware is highly desirable (Church and Smyth, 2009; Pew Research Center, 2014; Verkasalo, 2009). Early efforts in defining context come from the area of context-aware mobile computing. For example, Schilit and Theimer (1994), when designing an application disseminating active map information to mobile hosts, defined context as where you are, who you are with, and what resources are nearby. Ryan *et al.* (1997), when designing an archaeological assistant, defined context as the user's location, environment, identity, and time. In an effort to synthesize the existing definitions of context, Dey and Abowd (1999) pointed out several factors of particular importance, including time, location, activity, and identity. This has been echoed by a number of other researchers (Chua *et al.*, 2011; Church and Smyth, 2009). Based on these prior works, we defined five major contextual factors: time, location (where you are), activity (what you do), social surrounding, and technological environment. We will review them in relation to information seeking in the mobile environment.

Time is an important contextual factor for information seeking (Savolainen, 2006). Several studies based on transaction logs have shown that, information access via mobile phones varied in weekdays vs weekends and in times of a day, with the use peaking at night and on Saturdays (Halvey *et al.*, 2006; Nicholas *et al.*, 2013; Verkasalo, 2009). In relation to location, recent diary studies revealed that the majority of mobile searches were conducted when the user was outdoor or commuting (Church and Smyth, 2009; Komaki *et al.*, 2012). However, some others studies showed that users searched for information more often at home than at other places such as at work, because the phone offered quicker and more convenient access to the internet than computers (Nylander *et al.*, 2009; Verkasalo, 2009).

Users use smartphones for a wide range of activities. When seeking information, users tend to search for specific factual information, such as the date and location for a Jazz concert, or for information needs that have time pressure, such as finding the nearest gas station (Church and Oliver, 2011). When it comes to health information searching, studies based on transaction logs revealed that, similar to using desktop computers, users used smartphones to search for a wide range of health topics, including symptoms, causes, and treatments (Jadhav *et al.*, 2014). However, they are more likely to search for more private topics, such as sexually transmitted diseases and mental health conditions on their smartphones than on their desktop computers (Gullo, 2011). Moreover, searches on smartphones can be related to individuals' visits to healthcare facilities. Before the visits, searches for symptoms tend to increase; after the visits, searches for serious conditions decrease and, on the contrary, for commonly occurring conditions (e.g. caffeine withdrawal) increase (White and Horvitz, 2013).

In relation to social surroundings, recent studies suggested that social interaction with co-located people is an important motivation for conducting searches on smartphones. Searchers search information to prove a fact to colleagues or settle an argument with friends (Church and Oliver, 2011). Absar *et al.* (2014) pointed out that mobile information seeking is not necessarily synchronized with immediate social interaction; it can take place between individuals who are not co-located at the time of the search. For example, users may search for information on behalf of others. Thus, the authors argued that, in mobile environment, social context should also encompass concepts such as social capital, social networks, and social norms.

Technological environment, in information seeking, mainly refers to one's access to electronic devices that enable information searching and the network connections (Anagnostopoulos *et al.*, 2007). Nielsen and Fjuk (2010) pointed out that mobile devices,

including smartphones, are used to acquire information when personal computers were not available. However, more recent studies pointed out smartphones are the sole device for some people to access the internet (Smith, 2015). In terms of network connections, smartphones can access the internet through mobile broadband networks such as 3G or 4G (Generation), and regular Wi-Fi (Gorlenko and Merrick, 2003; Helb, 2011).

2.3 Barriers to access online health information
Users run into a number of barriers when searching for health information online. Barriers are often associated with personal factors, including one's economic status, education level, culture, language skills, computer literacy, health literacy, as well as perceptions of privacy (Courtright, 2005; Yoon and Kim, 2014). Barriers can also come from the environment, including the availability and readability of content, the volume of information available, and the usability of health web sites (Lee *et al.*, 2014).

Prior studies shed light on barriers that the Hispanic user group faces in online health information seeking. For example, large-scale surveys pointed out that a digital divide remained between Hispanics and other ethnicity groups, with the former lagging behind in internet and home broadband access (Zickuhr and Smith, 2013), as well as access to online health information (López *et al.*, 2011). Culture may present as a barrier, as Hispanics traditionally have larger family networks with close ties and such networks tend to become the main source for information and emotional support in times of illness (Diaz, 2002). Moreover, health beliefs rooted in traditions may also present as a barrier to health information seeking, as Hispanics generally believe less in the value of early detection (Diaz, 2002), and were more likely to turn to herbs, rituals, ointments, and various home remedies when it comes to treatments (Fitzgerald, 2010; Gordon, 1994).

The review suggests that, despite increasing attention to the adoption and use of smartphones, there is a lack of studies on users' adoption and use of smartphones to access health information, studies that focus on low-SES Hispanics are even fewer in number. Much has been known about barriers to health information seeking, but similarly, little is known about barriers that low-SES Hispanic users face. This study intends to fill this knowledge gap.

3. Conceptual frameworks and research questions
The conceptual framework that guides our inquiry (shown in Figure 1) was informed by three theoretical perspectives: the comprehensive model of information seeking
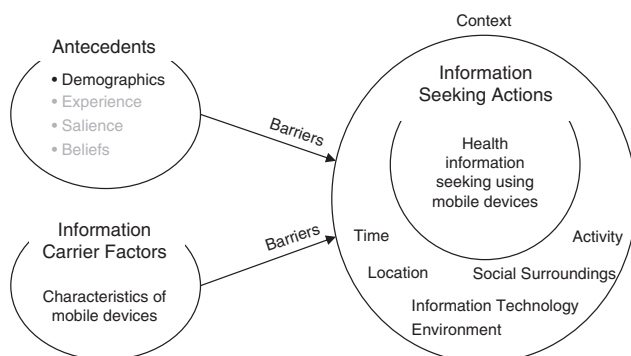

Figure 1.
Conceptual
framework

(CMIS) (Johnson, 1997), Wilson's information seeking model (Wilson, 1999, 2006), and a mobile context models in context-aware mobile computing (Dey and Abowd, 1999; Ryan *et al.*, 1997; Schilit and Theimer, 1994).

According to the CMIS, users' health information seeking is affected by a number of antecedents, including demographics and characteristics of information carriers (Johnson, 1997). Following this line of thinking, we postulate that users' health information seeking using mobile devices is affected by the population characteristics and the characteristics of mobile devices. In this study, we focus on a specific demographic group, low-SES Hispanic adult users, and explore the characteristics of smartphones that contribute to its adoption by this user group for health information.

Information seeking is always embedded in a certain context, and contextual factors influence information seeking behaviors (Courtright, 2007). To understand the context of health information seeking using smartphones, we adopted mobile context models developed in the context-aware mobile computing area, as reviewed in "Literature review" (Dey and Abowd, 1999; Schilit and Theimer, 1994). Collectively, these models suggested five contextual factors that are important to understand when designing for mobile computing: time (when), location (where you are), activity (what you do), social surroundings (who you are with), and information technology environment (what resources are nearby in the user's information technology environment). We examine the context of seeking for health information using smartphones from these five aspects.

According to Wilson's information behavior models (Wilson, 1999, 2006), barriers are an integral part of any information seeking attempts and may arise from the person him- or herself, the person's social roles, and the political, economic, and technological environment. Because the focus of our study is to understand individuals' health information seeking actions using smartphones, we focus on barriers related to users and to the technology (as shown by the two arrows in Figure 1).

Based on this conceptual framework, we proposed the following research questions:

RQ1. What are the characteristics of smartphones that prompt low-SES Hispanics adults to use them to seek health information?

RQ2. What are the characteristics of their usage context, specifically, time, location, activities, social surroundings, and information technology environment?

RQ3. What barriers exist, particularly barriers that arise from the users and the smartphone technology?

4. Research method
Because of the exploratory nature of the study and a lack of prior research on this subject, the semi-structured interview method was adopted, in which we asked participants to describe their experiences of using smartphones for health information as well as reasons for such usage.

4.1 Participants
In total, 20 low-SES adults self-identified as Hispanics were recruited for the interviews. The purposive sampling technique was adopted. Recruitment fliers were posted on a university-wide mailing list, and physical bulletin boards in several public libraries, churches, local restaurants, and local grocery stores. We also contacted potential participants at bus stations, in a Hispanic community center, and in free English

classes offered by a local community college. At the same time, a snow-balling technique was used to ask participants to recommend eligible others to participate in the interview.

To ensure the eligibility of the participants, prior to scheduling the interview, a screening survey was administered to collect information concerning potential participants' ethnicity, education level, income, smartphone ownership, and whether they had used smartphones for health information. As a result, the participants were Hispanics who had not obtained college degrees and belonged to low annual income (less than $30,000), owned a smartphone, spoke English, and had searched for health information using their smartphones. The interviews were scheduled at participants' convenience and in places designated by them. As a result, the interviews were conducted in various places including meeting rooms in public libraries, classrooms, teacher's offices, student lounges, break rooms, and outdoor seating in community centers.

4.2 Data collection and procedure
The data collection instruments included a demographic questionnaire asking for participants' basic demographic information, smartphone usage, health concerns, and experience with health apps, and an interview guideline. The instruments were pilot tested with two graduate students prior to the study and revisions were made to make several questions more understandable. The pilot interviews were not included in the data analysis.

The interviews were one-on-one. At the beginning, participants read and signed on the consent form approved by the Human Subjects and Institutional Review Board at the University of Texas at Austin. Then participants completed the demographic questionnaire. Then they were interviewed. In the interviews, they were asked to briefly talk about their general use of smartphones and their experiences of searching for health information using the phones. For each incident that they mentioned, follow-up questions were asked to elicit more detailed contextual information about the smartphone usage as well as barriers that they had. Examples of questions were: "when did you conduct the search? where?" "why did you use your phone instead of other means?" "how did you search?," and "did you have any difficulties in using phone this search?" to elicit more detailed contextual information about the smartphone usage as well as barriers that they had. In cases that participants did not provide sufficient information for us to make sense of context or barriers that they talked about, probing questions such as "can you talk more about […]," "are there any other reasons for you to […]," were asked. The interviews ranged 40-50 minutes. Interviews were audio recorded, upon the permission of the participants.

4.3 Data analysis
The demographic data were imported to Microsoft Excel and analyzed using descriptive statistics. Audio-recorded interviews were transcribed. The transcripts were imported into the NVivo 10.0 software and analyzed using the qualitative content analysis method (Zhang and Wildemuth, 2009). The initial coding schema was derived from the conceptual framework (Figure 1). The main categories included characteristics of smartphones, contextual factors (time, location, activities, social surroundings, and technology environment), and personal and technical barriers in using smartphones for health information. The coding unit was a theme.

The authors read the transcripts several times to get familiar with the content. At the beginning of the coding, the first author coded a subset of the data (three interview transcripts) using the initial coding schema. At the same time, an open coding process was followed. New themes and categories were allowed to emerge from the data. The second author independently coded the three transcripts following the same open coding procedure. Discussion sessions were held to discuss and solve coding discrepancies. As a result, a revised coding schema was developed. The first author coded all the data using the revised schema. The comparative coding strategy was used, that is, when coding a text unit to a category, it was compared to all texts that had been included in the category (Maxwell, 2012). Memos were also created and used to develop ideas and facilitate the recording of analytic insights in the process of the coding (Maxwell, 2012). To ensure coding consistency, the second author examined the coding for 20 percent of the transcripts and the inter-coder reliability reached 94.6 percent. When reporting the coding results, we also report the frequency of some themes. The numbers are intended to give a simplistic piece of context for the findings and should not be interpreted from a statistical point of view.

5. Results
5.1 Characteristics of participants
Participants' demographic information and experience with smartphones are shown in Table I.

Among the 20 participants (12 females and eight males), 18 (90 percent) had an annual income of less than $25,000, and 15 had only high school or less than high school education. The participants' age ranged from 20 to 60 (Mean = 34.6; SD = 13.8). In total, 15 participants (75 percent) spoke both English and Spanish, with the majority (13 out of 15) speaking Spanish as the first language; 11 participants (55 percent) reported having some kind of health-related concerns. The participants' experience with smartphones ranged from less than one year to more than five years. Nevertheless, all had used smartphones for health information.

Sources that the participants used on their smartphones for health information were categorized into mobile web sites and apps: the former refers to web sites that accessed through web browsers, and the latter refers to stand-alone applications installed on smartphones, shown in Table II.

Participants recalled five unique web sites that they had visited. Among these web sites, Google was the main site, with 18 (90 percent) reporting having used it. Mobile apps used by participants included apps that manage current health conditions and apps related to wellness. It is worth noting that, although participants reported using these apps, they characterized the usage as rare and minimum.

5.2 Characteristics of smartphones that support health information seeking
Five characteristics of smartphones contributed to participants' adoption of them for health information. Table III shows the number of participants who mentioned each characteristic.

The first characteristic was functionality and computing power. Smartphones are small-sized computers, allowing participants to not only make direct contact with others using voice call or texting, but also use a variety of applications and access the web. Thus, through smartphones, participants can not only seek health information,

Variables	No. of participants
Gender	
Female	12
Male	8
Age	
20-29	10
30-39	2
40-49	4
50-59	3
Over 60	1
Education	
High school or less	15
Attending college	3
Bachelor degree	2
Income	
Less than 20K	12
20-25K	6
25-30K	1
More than 30K	1
Language	
Bilingual in English and Spanish	15 (US-born: 2, Mexico-born: 13)
English	5 (US-born: 5)
Health concern	
High blood pressure	5
Obesity, diabetes, diet, exercise	4
Anemic	1
Gallstones	1
Flat feet	1
Sleep problem	1
No	9
Computer experience	
Less than 1 year	1
1-3 years	5
More than 8 years	14
Smartphone experience	
Less than 1 year	6
1-2 years	8
3-5 years	4
More than 5 years	2
Note: $n = 20$	

Table I.
Characteristics of
the participants

but also use other functions, such as checking locations and bus schedules to set up and make doctors' appointments; one participant mentioned:

I searched, [the websites] had doctors [and their contact information]. It's pretty helpful. I have GPS [like Google Map]; to drive somewhere, you [just] look it up and it [will] take you there. It makes everything so much easier. I just called [the doctor's office] and the phone [gave me the] right direction. [I just] clicked on the direction.

The second enabling characteristic was ease-of-use. For the participants, ease-of-use mainly referred to easy and quick access to the web. For example, one participant commented:

> My cellphone is a lot easier to log in. On my computer, I have to turn it on, and log in using my password. It takes longer. Sometimes my sister gets on Facebook on my computer. She has to log out. And then I have to log back in.

Being capable (computationally powerful) and usable may not be enough to prompt users to use smartphones for health information. Ubiquity, that is, the ability to carry and use smartphones from anywhere and at any time was another characteristic of smartphones that enables their adoption. Because of ubiquity, participants felt it was more convenient to use a smartphone at home or from anywhere, particularly when carrying a laptop computer was not an option, as one participant commented:

> I don't have to go home and do all these things on my computer, since I already have my phone. I can do it [on my phone].

The fourth enabling factor was the privacy characteristic of smartphones. Only one participant commented on this factor. He said that:

> Phone is on hand. I feel it is more private, [particularly when] what you are looking is private, [It is better than] computer monitors at public places such as libraries.

Being economical was the fifth factor enabling the use of smartphones for health information. Several participants reported that they had never owned computers and an internet service at home, and that their smartphones were the only devices allowing them access to the internet. For example, one said that:

> I don't have computers. I don't have a car either. I use buses and go to libraries. I have a cellphone. I can just search anywhere.

5.3 Context of using smartphones for health information

The context of using smartphones for health information was explored from five aspects: time, location, activities, social surroundings, and information technology environment.

Types	Sources	No. of participants
Web sites	Google, Yahoo, WebMD, YouTube, Wikipedia	18
Apps	Health-related apps: self-diagnosis/treatments, diabetes management, and heart rate monitors	11
	Wellness apps: exercise, diet, nutrition, body calculators, sleep assistance, and stress relief	

Table II.
Sources that the participants used on smartphones for health information

Characteristics of smartphones	No. of participants
Functionality and computing power	11 (55%)
Ease-of-use	13 (65%)
Ubiquity	13 (65%)
Privacy	1 (5%)
Be economic	6 (30%)

Table III.
Characteristics of smartphones

5.3.1 Time. Participants used their smartphones for health information during their free times, including both short breaks (3/20, 15 percent) and long period of free time (6/20, 30 percent). Short breaks included lunch breaks, time between classes, and breaks at workplaces. Long periods of free time included mornings before going to work, nights before going to sleep, and weekends. For example, one participant reported that "[I search for health information at night]. I like to use my phone at night. I access the internet and look at web sites for one or two hours."

5.3.2 Location. The locations where the participants used their smartphones to search for health information are listed in Table IV.

About half of the participants had searched at home, one participant reported that "whenever they [kids] are sick, I research on that. Usually I search at home." Four participants who had regular jobs reported searching for health information at workplace and four student participants reported searching on campus. Other public places where health information searching took place included buses, clinics, fast food restaurants, and grocery stores.

5.3.3 Activities. Participants reported performing a wide range of health-related search activities on their smartphones, as listed in Table V.

Most participants (70 percent) had searched for information pertaining to specific conditions, both acute (e.g. ear infection and cold), and chronic (e.g. asthma, pregnancy, and diabetes). For example, one participant searched for information on ear infections after she suspected that her husband might have it: "He was swimming. He felt like something in his ears. I tried to do something." The other participant reported that:

> After I was told that I had gall stones from the doctor, I searched it on Yahoo and found YouTube videos regarding gall stone.

Several participants did not have a specific condition in mind and searched for symptoms, such as cough, throat pain, and bruised foot nail, to make self-diagnosis.

Locations	No. of participants
Home	9 (45%)
Work	4 (20%)
Campus	4 (20%)
In transit (specifically buses)	2 (10%)
Other public places, including clinics, fast food restaurants, grocery stores, and swimming pool	10 (50%)

Table IV.
Locations where the participants used smartphones for health information

Search activity	No. of participants
Medical conditions	14 (70%)
Self-diagnosis	6 (30%)
Health providers	5 (25%)
Products and natural remedies	5 (25%)
Healthy eating	2 (10%)
Health-related news and articles	2 (10%)

Table V.
Search topics using smartphones

For example, one participant said that "you type in you are coughing, and [WebMD] gives you what could be the problem."

Participants also searched for information concerning health providers, including their addresses, costs, and reputation (ratings). For example, one participant reported:

> I searched for dental clinics for my son. I looked at some places close to my house. I compared locations. I also researched if it is cheaper or more expensive.

Participants also reported searching for health-related products, mainly supplements and natural remedies (e.g. herbal tea), and for healthy eating, mainly nutrition and dietary information. Two participants reported search for health-related news about new medications.

5.3.4 Social surroundings. Two levels of social surroundings were identified. One is the imminent social environment where a mobile search takes place, specifically, who is around; the other is one's social network. The former is more dynamic and ephemeral, and the latter is more stable and often serves as a background for one's mobile phone-based social activities. Table VI shows the two levels social surroundings in cases where participants searched for health information using their smartphones.

Searching for health information with the presence of family members was mentioned the most. The searches were often prompted by emergencies or healthcare needs that a close family member, usually children or husband, run into. For example, a young woman participant said that:

> When I looked at a skin rash on my daughter's face [at home], I didn't know what it was. I searched from Google. It gave me information and showed me a picture of people with skin rashes. I also found treatments for it. So I used it.

One participant, a college student, reported searching for health information in the presence of a friend during their conversation. He described:

> I talked about a piece of health-related information that I read on a website to a friend]; he asked me questions; I used my phone for searching for information for him because he did not have a smartphone.

Members of one's social network, although not present, may impact one's search for health information. Two participants mentioned searching for health information out of concerns about relatives, family, and friends. For example, a participant searched for a close relative:

> I have a niece who had Steven Johnson syndrome. It's like medical allergy reaction. My sister's a little girl was very sick and was almost dying. I looked it from websites [on my smartphone] and found what happened to my niece. The websites gave me [lots of] information.

Level	Social surroundings	No. of participants
Co-located	Family members	8 (40%)
	Friends	1 (5%)
Social network	Relatives, family, and friends	2 (10%)

Table VI.
Social surroundings of using smartphones for health information

5.3.5 Information technology environment. The information technology environment that an individual is situated in has an impact on their use of smartphones for health information. Three factors were found to be particularly relevant: computer ownership, access to Wi-Fi, and data subscription. Table VII shows participants' technological environment in relation to the three factors.

Five participants reported not owning a personal computer, making smartphones the only channel through which they could access the internet for information, including health information. For those who had computers, most of them would not carry their laptops during the day, so smartphones were a primary means to access the internet during the time.

Users can access the internet on smartphones through two types of connection: mobile broadband (3G or 4G) and Wi-Fi. Their availability impacted when and where participants have the internet connection. Among the participants, more than half (65 percent) reported using Wi-Fi at home and public places that have Wi-Fi, and using mobile broadband elsewhere. However, four participants did not have Wi-Fi at home, and had to rely on free public Wi-Fi on university campuses or in restaurants.

It is worth noting that seven participants did not use Wi-Fi anywhere. For four of them had a data plan that was sufficient for them, but the other three, it was because that they did not know how to use Wi-Fi.

Data subscription imposes a cap on how much information one can access using smartphones. Four participants reported having a limited mobile data plan, 2-3 Giga Bites per month. To ensure that they do not surpass the limit, they heavily relied on Wi-Fi at home or public places, such as fast food restaurants. For example, one said:

> I prefer to use Wi-Fi just because all the time it's faster and it doesn't use my data plan.

Another participant described that:

> I use [my smartphone] at McDonalds to get Wi-Fi connection. I also use it in my sister's house. She gives me a password. I can get free Wi-Fi. 2GB data plan is more than enough to me due to free Wi-Fi service.

5.4 Barriers to mobile health information seeking

Barriers to use smartphones for health information were categorized into those related to technology and those related to individual users. Table VIII shows the barriers identified.

Factor	Technology environment: access to Wi-Fi and data subscription	No. of participants
Computer ownership	No personal computers ownership	5 (25%)
Access to Wi-Fi	Use Wi-Fi at home	13 (65%)
	No Wi-Fi at home	4 (20%)
	Use Wi-Fi at public places	12 (60%)
	Not use Wi-Fi at any place	7 (35%)
Data subscription	Limited mobile broadband data plan	4 (20%)

Table VII.
Resources for the
internet access

5.4.1 Barriers related to the technology. Small screens, unsurprisingly, presented as a barrier for accessing health information. Six participants commented that navigation on small screens was difficult. It took them a long time to read content and to navigate pages with scrolling. For example, one participant commented:

> On computer, you can open a full Web browser and have multiple tabs to compare different things at the same time, and go back and go forward. You can have multiple [browsers] opens. [Mobile phones] make [the comparison] harder.

The other smartphone-related difficulty that users run into occasionally was that some documents could not open on smartphones as it did on desktop or laptop computers.

5.4.2 Barriers related to users. The first barrier was that participants lacked skills to use smartphones. The most widely mentioned difficulty was related to apps. Three participants reported having no knowledge about what an app was and that they were more comfortable with mobile web sites, as one described:

> I look at exercise, healthy living, cooking, and healthy foods on Yahoo. I don't use applications. There were websites. I just research and read from them.

The other participant (40 years old, high school education) reported not knowing how to download apps into his phone. In addition, another participant (51 years old, less than high school education) mentioned that she did not know how to access the internet using her phone.

Participants also demonstrated a lack of understanding of how search engines work and thus the deployment of less optimal search strategies. For example, one participant (44 years old, high school education) always searched for information by typing in www.keywords (e.g. www.insectbite) in the Google search bar on the home screen of her smartphone. She described that:

> My little boy had allergies, like seasonal allergies. I typed www.allergies into Google search bar. The google bar comes up with suggested websites. […] […] You can hit it on there.

The third user-related barrier was the perception of information overload. Specifically, five participants acknowledged that Google provided an easy way to find health information, but the sheer number of results returned made finding relevant and specific information particularly challenging. For example, one participant (60 years old) complained that she had a surgery for an eye problem, but had no idea what it was. She did Google searches, lots of information returned, but she could not find anything specific to her symptoms.

Category	Barrier	No. of participants
Related to technology	Navigation difficulties	6 (30%)
	Documents do not open on smartphones	1 (5%)
Related to users	Lack of skills to use apps and the internet	3 (15%)
	Lack of search skills	2 (10%)
	Information overload	5 (25%)
	Health literacy: lack of skills in evaluating health information	7 (35%)
	Health literacy: difficulty in language and comprehension	6 (30%)

Table VIII.
Barriers to health information seeking using smartphones

The other user-related barriers had to do with users' health literacy. Seven participants reported difficulties in evaluating the quality of health information. Particularly participants emphasized frustrations associated with information that is in conflict with other sources on the internet or with doctors' recommendations. For example, one participant (44 years old) commented that:

> Sometimes, I find some discrepancies of information found from websites. For example, when I was pregnant, I searched for information about pregnancy on the Internet. People on website suggest this medicine, which is different from what the doctor recommended.

Six participants reported difficulties with language. The major reason was that Spanish was the first language for many participants' (11 in total), but most health information was in English. Therefore, they had difficulty comprehending the information found. For example, one participant commented:

> Usually I use Spanish for health information. Sometimes, I use English, it is good, but I couldn't understand.

Several participants developed coping strategies. Three reported using translators or dictionaries on smartphones to help better understand health information. For example, a participant said:

> I usually use Spanish. I use Spanish from google translator on the phone to find terms in English. That is how I know what I search for. For example, when I search for "flue", I put "flue" in Spanish on the translator. Then I can see the English name of "flu".

6. Discussion

This qualitative study explored the use of smartphones for health information among low-SES Hispanics. One contribution of our study is that it offers a better understanding of the characteristics of smartphones contributing to their adoption and use in a significant everyday life context, seeking for health information, among low-SES Hispanic adults, a population historically underserved both in terms of access to technologies and to healthcare resources. Prior studies, mostly focussing on general consumers' use of smartphones for general purposes (e.g. getting directions or recommendations), have identified a slew of characteristics of the technology that enable its wide adoption, including ease-of-use, computing power and functionality, and ubiquity (Aldhaban, 2012; Kang et al., 2011; Kim and Song, 2009).

In this study, the same characteristics were identified as contributing to the adoption of smartphones for health information among low-SES Hispanics, indicating that seeking health information is an ordinary use smartphones in everyday life. Besides aforementioned characteristics, our study also revealed that two additional smartphone characteristics, preserving privacy and being economic, were important for its adoption and use. Preserving privacy was important because searching for health information is often a private task and users were not comfortable doing it on public computers. Being economical may not sound rational because smartphones are not cheap, particularly when adding the cost of a monthly data plan. But as some of our participants indicated, this cost was more affordable than that of personal computers and home internet connections. For these participants smartphones were the only means to access the internet. This is not surprising as national surveys indicate that the Hispanic population reports possession of fewer computers and less access to broadband connects at home than the non-Hispanic population

(Zickuhr and Smith, 2013). Thus, this finding suggests that smartphones have great potential to help bridge the digital divide and furthermore the divide in accessing health information.

To further characterize the use of smartphones for health information among low-SES Hispanic users, we explored the context of the use, including time, location, activities, social surroundings, and the technology environment. As a result, our second contribution is an enhanced understanding of low-SES Hispanic users' health information seeking behavior using smartphones.

In terms of time, our results suggested that low-SES Hispanic users, like general users, used smartphones to search for health information during short breaks throughout a day (Kivits, 2009). But they also searched health information when they had long periods of free time, such as after work at night or on weekends. This usage pattern might result from their limited access to computers and network connections at home.

In terms of location, like general users, our participants used smartphones for health information not only at home but also at public places, such as fast food restaurants, grocery stores, clinics, and public transits (Church and Smyth, 2009; Timmins *et al.*, 2006). But it is worth noting that the reason for them to search for health information in public places may be different from those for other user groups. As pointed out by several participants, they searched for information in public places because they did not have internet connections at home or their data plan was limited, and had to rely on free public Wi-Fi.

In terms of user activities, like general users, our participants used smartphones to search for a range of health-related topics, such as viewing health-related products, looking for doctors or medical facilities, and searching for dietary information. However, compared to the general population, our participants, particularly those middle-aged and older adults, relied mostly on mobile web sites for such information, while lacked experiences in using health-related apps. This is consistent with their report in the demographic questionnaire that they downloaded a number of self-care and wellness apps, but never or rarely used the most. Together, these results suggested that our participants were less sophisticated in using mobile apps for health information.

In terms of social surroundings, similar to general users (Absar *et al.*, 2014), our participants searched both with co-located family and friends and for family and friends who were not co-located. However, what is different was that, in these cases, most participants served as proxy, searching on behalf of others; few reported conducting collaborative search in which all parties engage in and contribute to optimal search results (Morris, 2013). In other words, the searches mostly were conducted by only one person. This result may be because the participants and their social networks lacked knowledge and skills to collaborate with one another in searching for information.

In terms of information technology environment, participants' search for health information was found to be affected by factors including the computer ownership, access to Wi-Fi, and data plan. For some participants, smartphone was the only device through which they could access the internet. More participants, because of limited data plan or no Wi-Fi connections at home, tended to heavily rely on free Wi-Fi at public places. These results suggest that smartphone ownership alone may not be sufficient for bridging digital gaps; attentions should also be paid to increase their access to networks. One way is to expand free access to public Wi-Fi.

The third contribution of this study is the identification of barriers that low-SES Hispanic users face in using smartphones to access health information. Our participants,

particularly those with low education and over 40 showed a lack of basic skills to use smartphones, including not knowing how to download and use apps. In addition, consistent with prior studies (Daniel, 2010; Fitzgerald, 2010; López *et al.*, 2011; Pena-Purcell, 2008), we also found some participants showed a lack of search skills and skills in evaluating the relevance and quality of health information. These difficulties indicate low smartphone literacy and health literacy among this group of users and suggest that, smartphone-based health interventions or services targeting this group should take these barriers into consideration.

It is also worth noting that the conceptual framework that we constructed based on three sources, Wilson's information seeking model, Johnson's CMIS model, and the mobile context model compiled based on the context-aware mobile computing literature, served the purpose of this study well. Wilson's information seeking model brought our attention to two important concepts, information source (in this paper, smartphones) characteristics, and barriers to information seeking. The mobile context model served as a nice framework to focus our attention to a limited set of important contextual factors for the mobile technology. Johnson's CMIS not only pointed out the importance of the knowledge about smartphones characteristics in understanding users' behavior of using smartphones for health information, but also provided a means to understanding the relationships among these concepts. We acknowledge that we have not utilized the full potential of the CMIS model in this exploratory study. The model will be highly valuable in guiding future quantitative research on mobile health information search behavior.

7. Conclusion

This study identified characteristics of smartphones that contribute to its adoption and use among low-SES Hispanics for health information, the context of the usage, and barriers that these users face. The results highlighted that, because of lower cost, smartphones have great potential to bridge the digital divide and the divide in accessing health information for this underserved group. However, making the technology available alone is not sufficient. Interventions at both personal and environmental levels are needed. At the personal level, interventions are needed to enhance their smartphone literacy and health literacy. More specifically, efforts should be made to teach users how to download apps, how to use apps for health information and disease management, how to effectively search for information, and how to evaluate online health information quality. At the environmental level, increasing this group's access to public Wi-Fi is needed. Policy makers, public health professionals, and technology sectors might consider offering free Wi-Fi internet access at more public institutions and places. In addition, having more health information in Spanish and at the recommend reading level (six-grade) would help this user group overcome language barriers and better satisfy their health information needs.

This study has a few limitations. First, the interviews were conducted in English. While all our participants were able to speak English, several of them were more fluent in Spanish. We recognized that conducting these interviews in Spanish may be able to elicit more information. Second, we used only the interview method. It deemed appropriate for the purpose of this study. But we also recognize that the study is exploratory and future inquires could benefit from the triangulation offered by other data collection methods, such as transaction log analysis, survey, user observation, and diaries. Third, a small number of participants would be limited to provide a meaningful insight into health information seeking behavior and smartphone use of this target population.

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About the authors

Henna Kim is a Doctoral Student at the School of Information at the University of Texas at Austin. Her research focusses on health information seeking and mobile information seeking behaviors. She is interested in information technology use serving health information to underserved populations.

Dr Yan Zhang is an Assistant Professor at the School of Information at the University of Texas at Austin. Her research focusses on consumer health information seeking behavior, psychological processes involved in people interacting with health information retrieval systems and consumer health information system design. Dr Yan Zhang is the corresponding author and can be contacted at: yanz@ischool.utexas.edu

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