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Qualitative Exploration of the Acceptability of a Mobile Phone and Pedometer Based Physical Activity Program in a Diverse Sample of Sedentary Women

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Abstract

Objectives—The objectives of this paper were to explore the acceptability of components of a mobile phone/pedometer based physical activity program and to understand motivators and barriers to increase physical activity in a diverse sample of sedentary women.

Design and Sample—Face-to-face semi-structured interviews were conducted following a 3-week pilot mobile phone/pedometer based physical activity intervention. Forty-one sedentary women participated in the study.

Measurements—Subjects were interviewed using a semi-structured interview guide. A qualitative description method was used to thematically analyze the interviews. Two investigators reviewed the transcripts independently and identified codes based on the main concerns in the interview questions.

Results—Three themes emerged from qualitative data shedding light on the perceived acceptability and usefulness of a mobile phone/pedometer based intervention: 1) Monitor me: mobile phone/ pedometer as self-monitoring tools, 2) Motivate me: cycle of feedback in goal setting and usefulness/uselessness of daily random messages, 3) Mobilize me: engaging and adapting physical activity to fit one's own lifestyle.

Conclusion—Mobile phone and pedometer based physical activity programs might be helpful in keeping sedentary women engaged and motivated to increase their physical activity. A randomized controlled trial of this intervention is warranted.

Background

Despite the reported health benefits of physical activity, approximately 50% of women in the United States do not engage in recommended levels of physical activity (Centers for Disease Control and Prevention (CDC), 2007). Furthermore, women are more sedentary than men. There is a need to find novel approaches to reach larger numbers of women to promote and maintain their levels of physical activity. One such approach is the use of mobile phone technologies.

Approximately 87% of American adults own a mobile phone (CDC, 2010). Various mobile phone functions and services such as short message services (SMS), multimedia messaging services (MMS), internet access, camera, video, Bluetooth technologies, and global positioning systems (GPS) are widely available. To our knowledge, only a limited number of randomized controlled clinical trials have examined the efficacy of mobile phone delivered physical activity interventions (Fjeldsoe, Marshall, & Miller, 2009; Krishna, Boren, & Balas, 2009; Fjeldsoe, Miller, & Marshall, 2010; Prestwich A, 2010) and the duration of these clinical trials have been relatively short, a few weeks to 13 weeks. The rapid growth of mobile technologies is creating new possibilities for the development of physical activity interventions, yet, it remains unclear as to how to design an effective physical activity intervention for these devices. We need to understand how to utilize mobile phones effectively in order to develop innovative outreach and intervention strategies aimed at encouraging sedentary women to increase their daily physical activity.

We developed and pilot tested an interactive physical activity intervention delivered through non-smart mobile phones. In this three week pilot study, sedentary women were asked to wear a pedometer to record their daily steps and to enter their daily step count into a mobile phone physical activity diary every night. The results of the quantitative analysis have been published elsewhere (Fukuoka, Y., Kamitani, E., Dracup, K., & Jong, S. S., 2011; Fukuoka, Y., Vittinghoff, E., Jong, S. S., & Haskell, W., 2010). Qualitative semi-structured interviews were utilized to better understand participants' experiences with this physical activity intervention. All subjects enrolled in the pilot study (quantitative part of the study) completed semi-structured interviews.

Research Question

The objectives of the qualitative interviews were to explore the acceptability of the components of a mobile phone based physical activity program (mobile phone application/ pedometer) and to understand motivators/barriers to increase physical activity using these components in a diverse sample of sedentary women. A long-term goal of this qualitative data analysis was to design a large randomized controlled clinical trial for this mobile phone/pedometer intervention.

Methods

Design and Sample

Forty-one women who were enrolled and completed the three week pilot intervention provided qualitative feedback through face-to-face semi-structured interviews at the end of

the program. Inclusion criteria were: 1) age 25 to 70 years, 2) ability to access a telephone at home and/or a mobile phone (in case study mobile phone was lost, we collected an alternate phone number), 3) able to speak and read English, and 4) a sedentary lifestyle at work and/or during leisure time (identified using the Brief Physical Activity Survey questionnaire) (Taylor-Piliae et al., 2010; Taylor-Piliae et al., 2007). Exclusion criteria were: 1) known medical conditions or other physical problems requiring special attention in an exercise program, 2) severe hearing or speech problems, and 3) current participation in another lifestyle modification program or research study. Women who had never used a mobile phone or who currently were not mobile phone users were not excluded. The pilot study was approved by the University of California San Francisco (UCSF) Institutional Review Board.

Study procedures—Participants were recruited from urban communities in the San Francisco Bay Area through newspapers and flyers; the recruitment materials asked potential participants to call the office for an initial telephone screening. Of the interested woman, 47 were determined to be eligible and were scheduled for a research office visit in San Francisco for baseline evaluation to determine eligibility for the study. Five women did not meet all inclusion criteria and one declined to participate in the pilot study secondary to difficulties in using mobile phone technologies.

At the baseline evaluation informed consent, sociodemographic and medical information was obtained. A brief face-to-face intervention was provided to all participants. This intervention contained five domains: 1) overview of the physical activity program (i.e. setting weekly goals), 2) education about the importance of physical activity, 3) counseling to identify barriers to increasing physical activity, 4) increasing social support for physical activity, and 5) safety for physical activity. Participants were trained to use the pedometer, respond to the daily message, and to use the mobile phone diary.

Mobile phone application—A custom-designed (Java2ME based) mobile phone application was developed for the study. We provided a basic no-smart phone (MOTORAZRv3xx) installed with the physical activity application to all participants during the three-week study period. The mobile phone was used as the means to: a) deliver the daily messages, b) set automated weekly goals, c) provide immediate feedback and self-monitoring function (mobile diary), and d) collect participant responses. The mobile phone application was designed to upload the participant's responses to a secure server upon exiting the application. An automated usage report was generated daily and sent to the research team allowing up to date monitoring of participant's mobile phone use. If no mobile phone activity was reported for three consecutive days, an automated query was sent to the participant, asking "Are you okay?"

Daily random messages (prompts): The daily random message addressed one of five content domains identified in the face-to-face intervention. Participants received one message (prompt) per day and were asked to respond using the pre-programmed answer choices on the mobile phone. The message was delivered between 9 a.m. and 4 p.m. and the timing of the message varied randomly from day to day. Each daily prompt included a message from the researcher, followed by a question relevant to the message. For example, participants received the following daily message from the researcher: "*Have you walked at*

least 10 minutes continuously since this morning?” Participants selected “yes” or “no” by pushing the keypad. Based on her answer, the next screen displayed written advice to take a 10 minute walk. Another daily prompt was “*What is the biggest barrier for you to be physically active today?*” Participants selected an answer from the list of potential barriers, and then received automated feedback to overcome the barrier.

Automated goal setting: Over a three week period, participants were asked to wear a pedometer all day and to record and send their total number of steps through the mobile phone before going to bed. The first week, women were asked to monitor their baseline daily steps. The second week, women were asked to increase their total daily steps 20% from their baseline steps. The third week, women were asked to increase their steps 20% from their second week’s daily average step count. The goals for the weekly average steps were automatically calculated and based on participants’ self-reported steps through the mobile phone. At the beginning of each week participants received a new daily step target goal.

Mobile phone diary: Participants recorded their daily steps in the mobile phone diary between 7 p.m. to midnight, the diary was programmed to be available only in this timeframe. Once data was entered and the application closed, the data was submitted to the server and could not be modified. The mobile phone diary was designed so participants were required to answer questions sequentially. For example, “*Did you wear a pedometer all day today, except for showering, swimming, or sleeping?*” if the answer was “yes”, they were asked to enter their number of steps in the diary. The participant immediately received a daily step bar graph reflecting her daily steps count for the past seven days. If the step goal was met or exceeded, a green bar was displayed and participants received the message, “*Excellent Job! Let’s get another green bar tomorrow!*” If they reached at least 50% of their goal, a yellow bar was displayed; if they were below the 50% level, they received a red bar.

Pedometer—An Omron HJ-720 ITC pedometer was used to measure total daily steps. It had a USB connection and PC software to download the data for analyses. This pedometer automatically stored the most recent 41 days of step counts.

Qualitative exploration of the pilot study—Following completion of the pilot study, all participants were interviewed by an investigator using a semi-structured interview guide designed to explore participants’ experiences and perspectives on using the mobile phone technology.

We asked questions related to the acceptability and usefulness of the program, adaptation to and barriers to the study devices (mobile phone/ pedometer), and participants perspective on certain aspects of the program designed to increase participants’ daily steps. Overarching exploratory questions included: “*What do you like most about the mobile phone/pedometer based physical activity program?*,” “*What do you like least about the mobile phone/ pedometer based physical activity program?*,” and “*How difficult was it for you to increase your daily steps by 20% per week?*” To enhance the usefulness of the program in future research, we inquired about the timing and content of messages: “*How often would you like*

to receive a daily message in the future?” and “What kind of messages/information would help motivate you to increase your physical activity?”

The average length of the interviews was 20 minutes ($SD \pm 13$) ranging from eight to 59 minutes. Interviews were digitally recorded and transcribed verbatim by a professional transcriptionist. Participants received \$20 to cover transportation and/or parking expenses.

Analytic Strategy

Alphanumeric identifiers were used to ensure participant confidentiality and audio files were kept on a secure device in a locked drawer in the research office. Transcribed interview data were imported into Atlas.ti (Muhr, 1997) to assist in qualitative data management and analysis. Qualitative description, an analytical approach to qualitative data that is “low inference” and more useful for researchers seeking to obtain minimally theorized answers to specific questions” (Sandelowski, 2000), was used to thematically analyze the semi-structured interviews. Two investigators reviewed the transcripts independently and identified codes based on the main concerns in the interview questions. The investigators compared their initial coding to see how well they were capturing the participants’ views of their mobile phone experience. Through this collaborative process agreed upon codes were defined and analysis continued. As additional codes were identified and compared, the two investigators collaboratively categorized the codes in clusters based on observed similarities that reflected emerging themes. Further refining of codes within themes allowed for clarification of meaning and identification of larger themes and relationships among the codes and themes. Descriptive statistics were used to describe the sample’s demographic characteristics.

Results

Baseline Sample Characteristics

The mean age was 48.4 years ($SD \pm 13.1$) with an age range of 25 to 70; 41.5% of women were Caucasian, 26.8% Asian, 12.2% Hispanic, 9.8% African-American, and 9.7% biracial or other; 51.2% never married; 95% lived in San Francisco; 60.9% completed four years of college; 51.2% worked part-time or full-time; 31.7% had an annual household income less than \$20,000 and 24.4% had > \$20,000 but < \$40,000. Mean Body Mass Index (BMI) was 33.3 kg/m^2 ($SD \pm 10.0$). Only 9.8% had used a pedometer during the 12 months prior to study enrollment; 87.8% of women used a mobile phone at least once a week during the last month prior to study enrollment.

Interview Data

Three themes emerged from qualitative data that shed light on the perceived usefulness and acceptability of the mobile phone/pedometer based intervention: 1) Monitor me: mobile phone and pedometer as self-monitoring tools, 2) Motivate me: cycle of feedback in goal setting and usefulness/uselessness of daily messages. 3) Mobilize me: engaging in and adapting physical activity to fit one’s own lifestyle. For most participants, the mobile phone program functioned as a virtual coach motivating them to be physically active. Mobile virtual coach refers to a program focusing on an existing issue (i.e. sedentary lifestyle) and

specific skill development (i.e. increasing steps/day) to produce a positive outcome (i.e. improved health) that individuals intend to achieve.

Monitor me—The mobile phone diary and pedometer acted as a powerful self-monitoring tool. This was most frequent theme that came up during the interview. Women had been aware that they were sedentary, but the majority of women had never quantified their physical activity (daily steps) before. Using a pedometer and entering their daily steps and types of physical activity every night provided a self-monitoring tool for a developing awareness of how sedentary their lifestyle was.

“I really liked being able to see what I had done. And I can say, not exercising at all is a condition of extreme unconsciousness. And so, it just brings some form of exercise into consciousness. To be able to see how little or how much I did and how was I feeling and why did those things occur and how did I feel about it. It was just an awesome wakeup.” [65-year-old Caucasian]

Furthermore, the combination of a physical activity mobile diary and pedometer works synergistically as a self-monitoring tool.

“Wearing the pedometer helps but this whole reporting thing (diary) helps you set a goal. It is motivating, and also, the step I also have to put a number of steps in the evening every day, so that is part of my goal for the day. So it is really helpful.” [30-year-old Asian]

Some participants found the programming of the mobile phone diary limiting; it allowed participants input their daily steps from 7 p.m. to midnight to prevent back-or-forward filling of data. What frustrated participants the most was missing the deadline and the subsequent “loss” of their daily steps.

“There was one night that I totally lost track of time and I thought, I need to enter my steps before I go to bed but it was already too late.” [57-year-old Caucasian]

“Am I supposed to do it (input my steps) now even though I am not done moving? And I thought, ‘no, I am getting credit for all of it.’” [50-year-old Caucasian]

Motivate me—The cycle of feedback and daily messages motivated participants to become more physically active. Subjects identified two sub-themes of motivation in the study: 1) cycle of feedback in relation to an individualized short-term goal setting, and 2) usefulness and uselessness of daily messages prompts. Although the feedback and messages that participants received were pre-programmed and not individualized, they had value for the participants.

Cycle of feedback related to an individualized short-term goal setting as motivators:

Participants talked about how they felt about the received feedback messages and suggested other kinds of motivational messages. The most popular feature of the program was a colored-bar graph that displayed the number of steps during the past seven days, followed by the encouraging message, “*Excellent Job! Let’s get another green bar tomorrow!*” Participants indicated that immediate feedback was helpful and motivated them to reach

their goals and continue in the program. Moreover, approximately 44% of subjects reported receiving the “*Excellent Job!*” message.

“I liked the messages that said, ‘can you get a green bar tomorrow?’ because that ’s kind of like a challenge. So they were good. Um, maybe I would add more during the day that would say, ‘Remember you are counting your steps, what your numbers are going to be?’ you know, make it sort of competitive.” [54-year-old Caucasian]

Coaching is mainly task oriented, focusing on an existing issue (i.e. sedentary lifestyle) or a specific outcome (i.e. total steps/day) to be achieved. However, some participants appeared to seek a counseling type of interaction, not simply coaching, through the mobile phone. One woman said:

“For example, just say “excellent”, “great job” and then maybe ask another prompt like “how do you feel”, “how does that make you feel that you did so well?” and then, “great, let’s get another green button”. Yeah, let’s get another green bar. Something between that that is more personal.” [60-year-old Caucasian]

Another woman wanted a response more reflective of her achievement than the “*Excellent Job!*” and green bar.

“I remember one time I had like the highest I ever had and I was looking for what are they going to tell me. I was disappointed. Forget the green bar. Can you acknowledge me for what I did today?” [69-year-old Hispanic]

The mobile phone application established daily step goals for subjects by automatically calculating a 20% increase of steps from baseline to weeks two and three. Numerous women remarked on the usefulness of setting measureable goals; visible achievement of that goal provided continuing motivation.

“I remember when I would walk 12,000 steps and over that little chart that showed me you know, “good job” kind of motivated me like I made a goal. So what I would like to do is continue, to do some aerobics to get my heart rate going to the optimal level and just have a measurable goal” [37-year-old Hispanic]

Usefulness and uselessness of daily random messages: Thirty nine percent and 34.1% reported they would like to receive the daily message once or twice a day, respectively. Participants discussed the importance and usefulness of having a daily message and although the daily message might not prompt immediate action, the idea presented in the message appeared to stay in the women’s consciousness for a few days.

“One of the prompts was ‘get a friend or a family member to walk with me.’ So I said no, but then the next day, somebody came over with her dog and she was on her way to walk the dog and wanted someone to walk with her. I was like, ‘Oh!, that was in my prompt yesterday! Sure we can go walk together.’ So that was fun having that prompt and giving me the option and challenge of what would it take for me to ask somebody that I know.” [29-year-old African American]

It is important to note that our daily messages were not universally liked or suitable. Approximately 15% reported that daily messages were not helpful. Additionally, some women reported that daily random prompts did not match their lifestyles and activities, or appeared at an inappropriate moment in their daily activities. For example, one of the daily messages advised women to take a short walk before turning on the television. One subject reported: *“I have two small children. I simply don’t have time to watch TV.”* [40-year-old African-American], another stated, *“The daily message was not helpful for me, but the diary (was helpful). A half of the questions (for the daily message) were dumb.”* [30-year-old Asian]

Nevertheless, some stated that the prompts did stimulate further engagement in physical activity:

“I liked having the questions on how I was going to manage it. Even though sometimes they weren’t applicable to me, it made me start thinking. I enjoyed that because it made me think more about my walking during the day so that I increased steps.” [57-year-old Caucasian]

Mobilize me—The virtual nature of the intervention allowed participants to engage in and adapt physical activity to fit their lifestyle. To achieve their step goal, women developed strategies to increase their physical activity suited to their lifestyle. Some women intentionally started walking instead of using a car or bus. One subject reported she cancelled her newspaper delivery, requiring her to walk to a newspaper stand four blocks from her house.

“I liked that it encouraged me. There were several times when I was at a bus stop and I could see what time the next bus was due, and if I had enough time to walk to the next stop, I would do that.” [54-year-old Caucasian]

It appears that women realized that they needed to be consciously active throughout a day to meet their weekly goals, *“Not just, oh I raced around today or did a bunch of errands, but taking time to make sure that a certain goal was achieved.”* [59-year-old African American]

Approximately 16% had difficulty with some of the expectations of program such as increasing their steps by 20%.

“Personally for me, it’s quite a jump of 20%, for someone who is out of shape. It was like a beginning rush, but if you do that in the first week, then the second week it’s steep. 20% for the last week was just out of reach because it was about 6,000 steps.” [62-year-old Caucasian]

Discussion

The purpose of this qualitative investigation of a three week pilot study was to explore participants’ perspectives on the acceptability of components of a mobile phone and pedometer based physical activity program and to understand motivators and barriers to increase physical activity in a diverse sample of sedentary women. Overall, participants perceived the program positively but it is important to note that the investigator conducting

the interview also delivered the intervention, potentially influencing participants' responses. However, no participant withdrew during the pilot study indicating overall acceptability of the intervention.

Our analysis revealed how the participants used the mobile phone program and how it encouraged them to continue towards their physical activity goals. Quantitative analysis of this study (Fukuoka et al, 2010, 2011b) demonstrated the mobile phone intervention was feasible, and the number of average steps increased over three weeks. Qualitative analysis highlighted the acceptability of different parts of the intervention. Thematic analysis of the qualitative data indicated the mobile phone physical activity program acted as a virtual coach, motivating sedentary women to be physically active. From the participants' perspective, it appears the combination of programmatic aspects acts synergistically to keep the women working toward their goals. Coaching the subject to monitor behavior is an effective method of behavior change (Elder, Ayala, & Harris, 1999). The phone diary was a simple motivator and self-monitoring tool. Providing colored-visual feedback (e.g. a green, yellow, or red bar graph) followed by positive feedback appeared to effectively encourage most women to strive to attain their physical activity goals. However, some participants wanted more tailored feedback. An advantage of the pre-programmed mobile physical activity diary is the ability to provide automated feedback immediately after subject's data entry, reinforcing future usage. A disadvantage is that pre-programming limits tailoring of feedback messages.

Our results are similar to previous studies using eHealth Interventions effecting behavior change (Norman et al., 2007). In a web-based physical activity and weight management program, visual feedback (weight graphs and charts) were the most liked part of the program by the study participants (Ware et al., 2008). Mobile technologies have the ability to automatically set slightly challenging short-term goals, assess smaller milestones, and provide immediate feedback (Norman, et al., 2007), ultimately, enhancing the likelihood of attaining long-term goals. However, the preset goal of 20% was too challenging for some participants and the program left little flexibility for more individualized goal setting.

One- or two-way mobile phone SMS have been the most frequently tested technologies for behavior change or self-monitoring. They have been shown to be feasible and effective for at least a short period of time. (Fjeldsoe, et al., 2010; Fukuoka, Kamitani, Bonnet & Lingren, 2011) Unlike SMS, the daily messages were programmed into the application installed on the mobile phone, yet, these messages played a similar role to a two-way SMS. The daily messages were designed to prompt immediate response, but their impact might be felt for several days or longer. Identifying a way to capture the latent impact of encouraging or suggestive messages could be useful in evaluating these kinds of programs.

The greatest requirement for a future program is that the content, timing, and frequency of daily physical activity messages be relevant to a woman's needs and lifestyles. Messages in the pilot study were delivered randomly, between 9 a.m. and 4 p.m. It is unclear how the timing impacted participants' physical activity. Additionally, if women felt the messages are not applicable to their life, they may ignore or get irritated by them. (Intille, 2004) The

ability of a program with automated messages to truly address individual needs is a challenge.

Daily messages can be delivered by different modalities (text, video clips, voice, picture etc), we did not explore women's preferences for these modalities. Consideration of preferences should be evaluated in future programs.

Mobile technologies are emerging platforms for virtual coaching in health promotion. Building an initial coach and participant relationship, increasing perceived value of the program, and enhancing self-efficacy of the technology utilization prior to initiating the program appear to be critical components of launching the virtual program (Ding et al., 2010). Lack of established measurement tools prevented us from evaluating changes in these components. The brief face-to-face intervention and hands-on mobile phone application training may play an important role in promoting these components. Strategies for mobile phone interventions, particularly, developing ideas for mobile virtual coaching are still in preliminary stages and further research is needed.

Our results should be interpreted with the following limitations. First, the qualitative evaluation of the mobile phone and pedometer program was limited in its scope to exploring participants' perspective of the acceptability and usefulness of the program. Thus, the responses focused on how women viewed and used the program and how different aspects of the programming worked for them. More in-depth responses, those potentially capturing the participants' general views of physical activity (e.g. how it fits/does not fit into their lives, what maintains/discourages activity) were not elicited. These questions may have provided more complete understanding of how and why the program worked or did not work within the context of individual women's lives. Second, the duration of our pilot study was short. Women might be excited to be part of an innovative study and the pedometer and mobile phone program may influence short-term behavior. Thus, this mobile phone based physical activity program needs to be evaluated over a longer period. Lastly, the program was specifically designed and tested to increase physical activity in sedentary women. Research is needed to determine effectiveness in sedentary men.

A wide age range of women expressed interest in participating in a longer intervention. The pilot mobile phone based physical activity program proved successful in the short-term and women were able to fit it into their lives. Therefore, this type of mobile phone based physical activity programs might be helpful in keeping sedentary women engaged and motivated to increase physical activity.

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