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ORIGINAL ARTICLE

# Youth-centered design and usage results of the iN Touch mobile self-management program for overweight/obesity

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**Abstract** Overweight/obesity among youth is a grave concern in the USA due to its potential impact on illness such as hypertension, high cholesterol, type 2 diabetes and asthma. This paper reports on the design and usage of iN Touch, a mobile self-management application for tracking observations of daily living (ODLs) in a health coaching program for low-income, urban, minority youth 13–24 years with overweight/obesity. We applied a youth-centered, participatory design approach to design and implementation of the technology and intervention with a representative 10-member youth advisory board. The recommendations were implemented prior to launching the technology in an intervention phase. The application with food, exercise, mood and socializing trackers along with pictures and notes was delivered on an iPod Touch to 24 participants. Mixed methods were applied to evaluate technology acceptance including system-generated data, questionnaires and exit interviews. There was good engagement among participants who recorded 2,117 ODLs over 6 months. The mean rating for usefulness was 3.50/5, SD = 1.18 and for ease of use, 3.83/5, SD = 1.27. Qualitative analysis of exit interviews found that design recommendations were fulfilled and the resulting technology was compelling. Future papers will report on the health impacts of iN Touch.

**Keywords** Mobile application · Overweight · Obesity · Youth · Self-care · Participatory design

## 1 Background and significance

The USA has had one of the highest childhood obesity rates in the world [1] with minority and low-income populations being disproportionately affected [2–4]. Adolescents and young adults from 13 to 24 years old, whom we refer to collectively in this paper as youth, are particularly vulnerable to weight gain [5, 6]. Being overweight or obese puts youth at an increased risk of developing various illnesses including hypertension, high cholesterol, type 2 diabetes and asthma as they enter adulthood [7]. A systematic review of diet and exercise interventions for youth reported that on balance the interventions did not result in significant reductions in weight, but they did result in improvements in risk factors such as cholesterol and blood glucose levels [8]. There are several examples of efficacious intensive cognitive behavioral programs of diet and physical activity for youth although the findings were tempered due to high attrition rates [9, 10]. Self-management, the processes and actions driven by an individual to achieve or maintain their own health, is another strategy that has shown moderate positive results with obese adolescents [11]. Self-management with mobile technology is a promising tool to help youth increase health awareness [12] and decrease depressive symptoms [13]. Self-tracking is a type of individual self-management activity that relates to "measurement, science and technology, to bring order, understanding, manipulation, and control of the natural world, including

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the human body" [14]. Self-tracking includes journaling or collection of structured data by the individual related to thoughts and feelings, activities such as eating and exercise, measurements such as weight, or observations of signs and symptoms of illness. Collectively, these types of individually generated data are also called observations of daily living (ODLs) (www.projecthealthdesign.org). There are few examples of effective interventions using mobile self-management in general or self-tracking tools specifically for youth with overweight/obesity.

Participatory design is a philosophy in which the target users play an important role in the design of technology [15]. This philosophy sees technology as a process that is rooted in a particular context rather than simply a product. Participatory design has been applied to health technology but has been based on a clinically focused viewpoint in which the patient's role is to comply with the clinician's expert treatment plan [16]. An alternative perspective that is emerging is one of the patients as proactive agents and self-experimenters using technology to co-create health and quality in healthcare [17–19]. In this perspective, design of self-management technologies would be grounded in the reality of everyday life rather than a clinical encounter [20, 21], thereby supporting the appropriation of technology by users for maximum system use and usefulness. A variety of methods may be applied within a participatory design philosophy.

There are a few examples of participatory design in mobile self-management for youth. In one study, the authors described the design of a goal setting and self-monitoring application on a handheld computer device to increase consumption of fruits and vegetables that engaged a group of low-income female students as an advisory board [22]. In another, the development of a mobile tracking system for mood, stress and coping that utilized focus groups of high school students to inform design was described [23]. However, these programs have not matured to a point of demonstrating usage or impacting health outcomes.

Our objective in the iN Touch study was to assess whether and how overweight/obese youth using mobile technology to collect ODLs might better collaborate with a care team (including clinicians and a lay health coach) or improve their health. The mobile technology consisted of a self-tracking application for collection of ODLs on an iPod Touch. The intervention involved the provision of health coaching in a clinic setting in which the health coaches and participants had access to the technology and the recorded data over a 6-month period. Health coaches were supervised by clinicians, a primary care physician or school nurse, who also had access to summary ODL data reports. This paper reports on the youth-centered, participatory design of the technology and the intervention, implementation of the program, and results related to technology acceptance including usage. The health outcomes will be reported in a future paper.

## 2 Methods

A participatory design (PD) approach was applied to the focus group and structured testing methods utilized in the project. The elements of PD utilized in these methods included active participation of a youth advisory board (YAB) representative of target study participants, investigation of the use of technology in the lived experience, and incorporation of findings into the design and implementation. In the design phase, the iN Touch application was refined and the intervention program elements were designed. The application was tested, and potential challenges and barriers to use were identified. The implementation phase included the conduct of the intervention and evaluation of results. The detailed methods are described below for each phase.

### 2.1 Platform

The iN Touch mobile application was built on TheCarrot, a commercially available, HIPAA-compliant platform for publishing and managing health and lifestyle tools and data offered as a cloud service. Redesign of TheCarrot platform was not within the scope of the study. TheCarrot consisted of a mobile application with 25 preexisting trackers with entry of text, photos and numerical data. The platform supported easy modification of existing trackers or configuration of new trackers. The mobile application depended on an active Wi-Fi connection to transmit and access data. Data were accessible via the mobile application or the Web site. For this study, minor modifications were made to the food and exercise trackers and two new trackers for mood and socializing were proposed in order to provide psychosocial indicators of everyday behavior. Refinements to navigation within the application were also implemented. In addition, new features to allow the health coach to manage a group of participants were developed and made available on the Web site. The new features included (1) compilation of a custom configuration of trackers and features to be distributed to all study participants, (2) a dashboard for viewing the status of participants and drilling down to individual level ODL data and (3) uploading of batch ODL reports to an electronic health record.

### 2.2 Design phase with youth advisory board

The design phase focused on both the technology and the intervention including refinement of the trackers, the

selection of the mobile device, interactions between participants and health coach both through the technology and in person, and other aspects of implementation of the intervention. We began with several design assumptions. First, we assumed that allowing participants to keep track of their own ODLs would "create a more meaningful portrait of their own health", help them to understand and shape their daily health decisions more critically, and encourage more productive conversations with clinicians [24]. Second, participants would need to collect ODLs and have them accessible in real time which would require a mobile device connected to the Internet. Third, we assumed that youth face unique challenges and would need guidance during the intervention to understand their personal data and make behavioral changes. Past research has demonstrated that using motivational interviewing techniques [25] with youth may be effective in changing behaviors including those related to overweight/obesity [26–28]. Motivational interviewing techniques are more youth-centered than provision of didactic lessons or directions on how to lose weight. Finally, we assumed that our participants would prefer to meet with a near-peer health coach to discuss their goals, plans for behavior change, and ODL data rather than a clinician.

We employed a youth-centered, participatory design approach to refine the technology and adapt it for implementation in a health coaching program. A YAB of 10 members representative of the target participants was convened to provide critical input into design. The YAB members were recruited using flyers at San Francisco State University (SFSU) and through personal contacts. The YAB was convened once as a group for an informal discussion and once in a structured focus group. In addition, select YAB members participated in individual technology testing sessions. Through engagement of the YAB, we tested our initial design assumptions and explored the potential for appropriation of technology in the participants' personal context and environment [21]. The structured focus group lasting 2 h included a general discussion about self-management of health and specifics of the proposed iN Touch study. A voice-over, PowerPoint storyboard was created to describe the planned iN Touch application and the health coaching intervention. A focus group guide was developed to facilitate the discussion and included questions about features and functions of the planned application, potential barriers and facilitators of use of the mobile application, and elements of the health coaching program. The focus group was tape-recorded and verbatim transcriptions analyzed by two investigators. Investigators identified themes and abstracted design requirements. Participants and a parent/guardian for minors signed consent forms, and each participant was provided $20.00 for their time.

The recommended design of the application was implemented in collaboration with the technology partner TheCarrot, loaded onto an iPod Touch and tested first with members of the research team. After refinement of the application, six members of the YAB participated in individual 1-h user testing sessions at SFSU in which a research assistant presented a comprehensive user scenario demonstrating step-by-step use of the application. The research assistant then observed as the YAB member used the application. Finally, the research assistant conducted a semi-structured interview to collect feedback. The interview questions included: What did you like, what didn't you like, what would you change, how would you improve it, how easy or difficult is this for you, was there anything difficult to understand or unclear in the application, what would prevent you from doing this each day, and do you have any additional comments. The results were compiled, and required changes were made to the application.

### 2.3 Intervention phase

Intervention participants were recruited from a pediatric clinic and a teen/young adult clinic at a public hospital and a nearby high school in a low-income neighborhood. Flyers were posted at all three sites, and the clinic medical director and school nurse identified candidates and referred those who were interested to the research assistant for screening and enrollment. To be eligible, candidates needed to be age 13–24 years, have a BMI $\geq$85th percentile for gender and age, have no significant medical conditions or severe depressive symptoms, and be English literate. Participants met with a health coach who utilized a motivational interviewing-based health coaching approach over a 6-month intervention period. Each participant developed his/her own health goals and action plans for accomplishing the goals, in consultation with the health coach. The participants used the iN Touch mobile application to track ODLs, and review recorded data. The health coach also reviewed ODL data and met with the participant periodically (at a frequency agreed upon with the participant). The clinicians, either the physician or school nurse, had access to summary reports of ODLs for their own patients and the health coach communicated directly with them regarding any issues of concern. Participants were offered $10 for participation in each of the initial and exit interviews and were given the iPod Touch to keep on conclusion of the study. No other incentives were offered.

Assessment of the technology was conducted via mixed methods. Use, which is a behavior indicating interaction with the mobile application, was measured based on system-recorded number and type of ODL entered (including

**Table 1** Youth advisory board design recommendations

| Theme | Design recommendation |
|---|---|
| Flexibility and individual control | Offer an individualized schedule of when and how often to record ODLs |
| | Provide ability to see trends/track progress, reports and analyses |
| | Provide help from the health coach to understand the data and build health numeracy skills |
| | Select own frequency and mode of interaction with coach, e.g., face to face or phone |
| | Provide an orientation to the technology |
| | Do not send mass messages, personalize it |
| | Allow participant to decide who sees his/her data |
| Non-judgmental, supportive approach | Advise clinicians and health coach to refrain from making judgmental comments or lecturing youth about ODLs recorded |
| | Be patient with youth who may not want to share feelings and thoughts |
| | Respond quickly (same day) to texts and messages |
| Share context | Be able to write notes along with ODLs to give context to health coach and care team |
| Technology support | Conduct a technology orientation |
| | Provide replacements for lost or broken devices and any needed accessories |
| Minimization of data entry requirements | 5 min/5 touches: Be able to fulfill all required tasks in 5 min a day and in 5 touches per task |

date and time stamp for each). A pre–post-questionnaire was also developed. The pre-questionnaire included questions about previous technology experience and expectations while the post-questionnaire included questions aimed at gauging technology acceptance. The technology acceptance concept includes two constructs: (1) perceived usefulness—a user's beliefs about the applicability of the system to performing goals and activities, and (2) perceived ease of use—a user's beliefs about the level of effort required to interact with the system [29]. Finally, individual exit interviews lasting 15–30 min were conducted after the final health coaching visit at the high school wellness center or hospital clinic. The exit interviews included questions about participants' use of the technology, facilitators of and barriers to use, and recommendations for improvement of the application. The recordings were transcribed verbatim and analyzed by two researchers who discussed qualitative themes. All phases of the project were approved by the Institutional Review Board (IRB) at San Francisco State University (SFSU) and University of California San Francisco/San Francisco General Hospital.

## 3 Results

### 3.1 YAB design recommendations

We recruited a diverse group of 10 individuals aged 15–29 years representing 6 race/ethnicity categories for the YAB. Six members were female. The YAB suggested a number of important design suggestions on application features, intervention features and potential adoption challenges. The themes that were abstracted from the YAB focus groups included flexibility and individual control, non-judgmental approach, ability to share context, technology support and minimization of data entry requirements in order to meet the needs of participants. Several quotes from the YAB illustrate the significance of some of these recommendations. For example, one YAB member described the importance of a non-judgmental approach. "Yeah, it would definitely be easier if it was someone like similar to our age, whereas like… I know with my doctor I sort of feel like he's judging me sometimes." Another said, "I think the way that they talk to you too because a lot of the time when I go to the doctor, I feel like I'm getting interrogated. Like they go through a list of everything they need to ask you…and I'm like what about my feelings or like you know what about, how do I, like kind of check-in on a more personal level."

Another significant YAB discussion centered on how the ability to enter free text comments offered participants an opportunity to provide context for their food choices, not only for their own awareness but for the health coach or clinician to understand the circumstances surrounding their choices. One YAB member said "Is there a way that maybe like also you can share like your food environment…like you didn't want to eat the free lunch. It was cool to eat the pay lunch and so I had cup-a-noodles and hot chips every day."

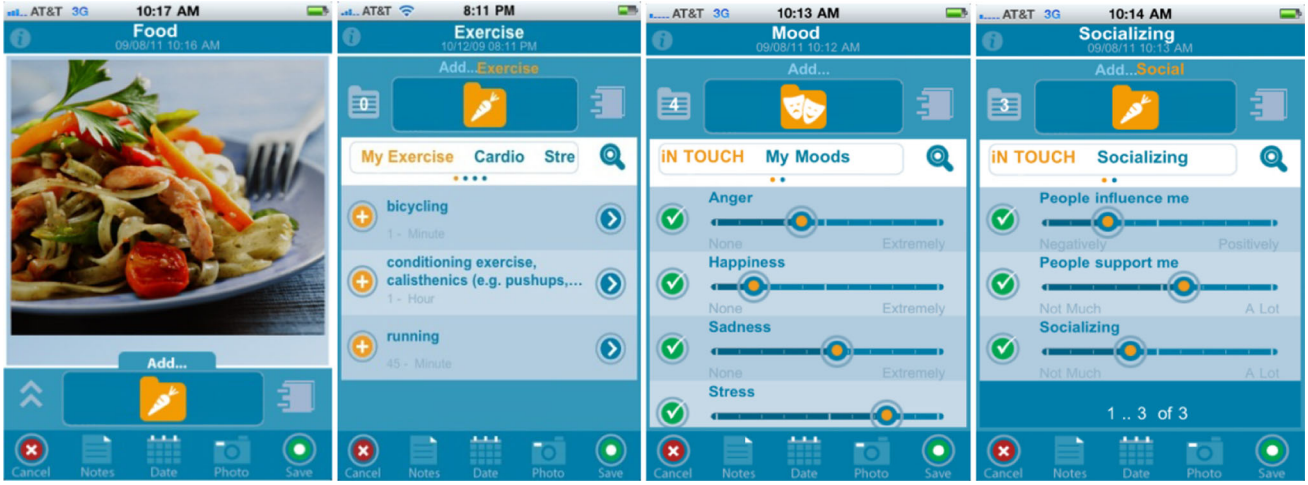
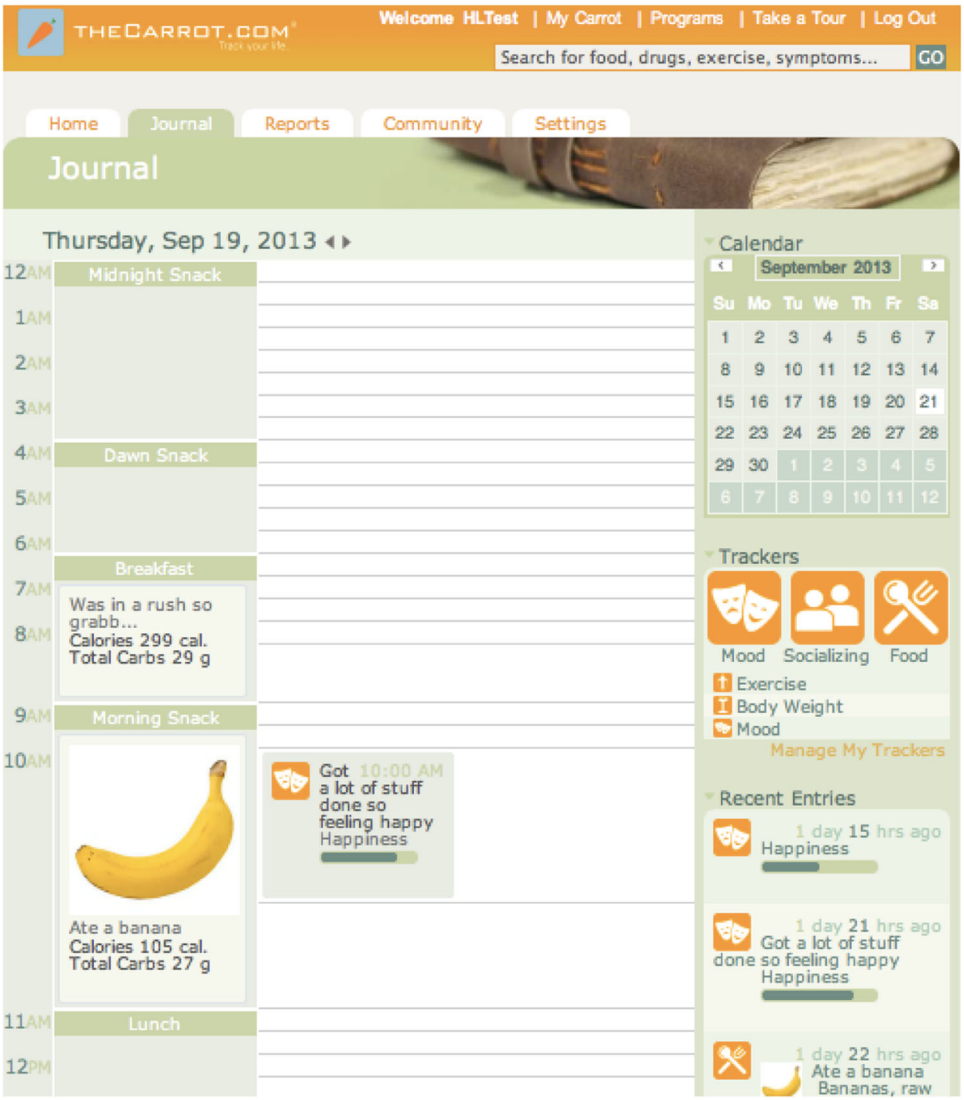



**Fig. 1** iN Touch mobile self-trackers for observations of daily living (ODLs)

**Fig. 2** iN Touch daily journal web view



Finally, the YAB emphasized the need for convenience and minimization of the data entry burden. "When I collect the data, I don't want any more than like five touches. I don't care about the time, but it better be like real quick, like five. Five is my limit, pushing it." Potential challenges the YAB raised were the lack of ubiquitous Wi-Fi, the prohibition on use of devices and access to the Internet at some schools and the inability of participants to pay any additional out of pocket costs such as replacements for lost and broken devices or connectivity.

Specific recommendations under each of the themes are described in Table 1.

The YAB members who tested the technology found the iPod touch to be intuitive and the application easy to use and understandable. All YAB testers were able to navigate the application, enter and retrieve data immediately after the brief overview by the research assistant. The overview was the basis of the orientation provided to participants in the intervention phase. The testing resulted in minor modifications and bug fixes.

### 3.2 Final design

Participants were provided a 16-GB third-generation iPod Touch with camera, a texting application, Wi-Fi finder, and customized iN Touch ODL tracking application that included exercise, food, mood and socializing trackers, supplemented by photos and notes that were inserted into a daily journal along with tracker entries. Figure 1 shows the four trackers packaged into the iN Touch application. Participants were able to add other trackers from TheCarrot's library, but data from additional trackers were not made available to clinicians. The entries from each tracker were inserted into the daily journal at the time they were entered and participants could add any text notes or pictures. The full view of the daily journal was accessible on the web but not in the mobile application. See Fig. 2 for the daily journal.

The technology supported the creation of a group by program (e.g., iN Touch San Francisco) and by provider (e.g., clinic 1, clinic 2 and school wellness center) to control access to data. The health coach had access to all data for the participants assigned to them. Although all participants agreed their physician at the clinic and school nurse could access the weekly summary report (this was included in the consent form), a feature allowing patient's approval of provider access was also created as this was considered important for future implementations. The ODLs entered by participants were compiled into an individual weekly summary for providers and delivered through the EHR at the hospital clinics and through a web portal for the school wellness center nurse.

Based on the YAB recommendations, the intervention design was also refined. A 30-min orientation was conducted by the research assistant with each participant at enrollment. This orientation included instruction on the application, setting of a password on the iPod Touch for security, the policy on replacement of devices and a written agreement of expectations for use of the technology. Participants met in person with a lay health coach once at the beginning of the study and once at the end. At the initial meeting with the health coach, expectations were set as to the participant's desired frequency of meeting, type of follow-up, mode of communication including alternate phone numbers, and response time from the health coach during the week. During the intervention, participants selected how often they met with the health coach. They also received personal messages and reminders from health coach either by text or by phone call. The motivational interviewing-based coaching approach met the recommendations for a non-judgmental, supportive approach, and was retained.

**Table 2** Observations of daily living recorded

| Observations of daily living recorded ($n = 24$) | | |
|---|---|---|
| Type | Number | |
| Exercise | 398 | |
| Food | 1,195 | |
| Mood | 341 | |
| Socializing | 183 | |
| Total | 2,117 | |
| | Range | Average |
| ODLs per participant | 1–699 | 88.21 |
| Number of days recorded | 1–179 | 28.38 |
| ODLs per day (including only days when at least one ODL was recorded) | 1–4.50 | 3.11 |

### 3.3 Use results

We report the use results in this paper. Health outcomes will be reported in a different paper. Thirty-four participants were enrolled in the study. Twenty-one (61.8 %) participants were recruited from the high school clinic. The majority of participants were female (73.5 %), and the mean age was 18 (range 13–24) at the beginning of the study. The participants were almost all minorities: sixteen (47.1 %) were Hispanic/Latino, seven (20.6 %) African American, five (14.71 %) Asian/Pacific Islander, two (5.8 %) mixed/other and four (11.7 %) unknown. At the start of the project, seven (21.2 %) participants reported that they never use a smart phone, 12 (36.4 %) seldom use a smart phone, six (18.2 %) use one a lot and eight (23.5 %) use one "all the time." All but one participant use the Internet at least 1 day per week.

Among the 24 participants who completed the 6-month intervention, a total of 2,117 ODLs were recorded, an average of 3.11 ODLs per day with the denominator being the number of days when at least one ODL was recorded (see Table 2). Over half of all ODLs recorded were of food (56.45 %). The number of days recorded (range 1–179, $M = 28.38$) and number of ODLs (range 1–699, $M = 88.21$) varied substantially among participants. The 10 non-completing participants recorded far fewer ODLs (range 2–103 $M = 40.0$).

### 3.4 Perceived usefulness

Participants were asked how much is the iN Touch application affecting your ability to become or stay healthy on a scale of 1–5 with 1 being not at all easy and 5 being very easy. The mean rating was 3.50, SD = 1.18.

Participants reported the application was an effective way to see patterns about their health behaviors and make health changes. For example, one participant said, "Well at the beginning, when I would write down, when I would put in what I ate, I would notice that for the first week, second week, third week, the pattern with the food I would be eating. So first week, sprite throughout 3 days, next week sprite two more days, I would notice the pattern of what I was doing work. That is what made me understand what I'm doing wrong." Another said, "I saw a lot of snacks at random times, I was like dang, I snack a little too much and it wasn't like healthy snacks, it was like chips and cookies and juice and stuff."

Others reported that the application helped them make behavior changes. "Like with the iN Touch, I started walking a lot more than taking the car somewhere, cause I can drive now and instead of me just going to the store, it depends on what store it is, if it's the store that is just a few blocks up, I will just walk there." Another said, "Like do you really want people seeing you ate 5 cheeseburgers or whatever! Like you know, it's embarrassing. So you just don't eat it and you forget about it. It is helpful cause obviously I ate a burger yesterday, compared to my roommate who ate two burgers."

### 3.5 Perceived ease of use

Participants were asked how easy the iN Touch application is to use on a scale of 1–5 with 1 being not at all easy and 5 being very easy? The mean rating was 3.83, SD = 1.27. Participants agreed that the iN Touch technology was easy to learn and use throughout the program. They indicated that the first meeting in which they were given a brief training on the application was useful and allowed them to adopt the technology quickly. As one participant stated, "But um, the actual technology was easy to use, it wasn't complicated, you know after it got explained to me how to use it. It was important to have that first introduction because I would have been confused. I would have been like, what am I supposed to do?"

Participants enjoyed the ability to take pictures and write notes in a journal and add other trackers from The-Carrot.com. "The app was easy. And the fact that you could pick different exercise, food, I think I even put the sex one in there. Sleep. When I went online, there was a new one, the quit smoking. I like the fact that you can measure different things or keep track of different things, so it's not just about weight loss, it's about a whole genre of things."

Participants felt that the iPod was convenient and portable. A few of the participants were worried about the device being lost or stolen and reported that they left it at home when they went to certain events. This sometimes impeded their ability to track ODLs since they had to try and remember what they had done and enter it later. Approximately 10 % of devices distributed in the program needed to be replaced, primarily due to loss.

Overall, tracking was not a big time commitment. The approximate time spent per day was reported to be 5–10 min: "Well it's just very easy, cause you just uh, you just take, describe it, it's just kind of like texting and uploading photos, well kind of like that, it's just really easy, it's just like 10 min, you're done."

Almost all participants reported that the exercise, mood and socializing trackers were very easy to use and took little time. The food tracker in the iN Touch platform was the most difficult to use. Participants felt it was difficult to find the exact food they were looking for and they did not enjoy having to enter each ingredient. "…the food one was a little harder. You had to like pick certain stuff, like you couldn't just pick like oh I ate a sandwich or I ate a burger or like I ate a bowl of cereal. You had to like pick like the type of cereal and like how much of the milk…and I was like dude…" Some participants reported that they used the journal feature or picture feature for food as these features required fewer steps.

Most of the youth found the application easy to use and the iPod convenient and portable. One commonly recommended improvement was an auto-save feature. Participants found themselves at times exiting out of the application before they hit the save button and not realizing the data were erased. One participant said "I was thinking I was doing it and sometimes my health coach would be like 'Oh you forget' and I'd be like 'Oh my god, I swear I did' and she's like, ugh you're supposed to hit the green button. Wow. It would be nice to save at least to a draft or something. Like save it into drafts."

### 3.6 Barriers to adoption

Barriers to tracking that emerged during the exit interviews were lack of regular access to Wi-Fi and inconsistent tracking/other life priorities.

#### *3.6.1 Access to Wi-Fi*

The most common barrier reported in the exit interviews was the lack of Wi-Fi. Many participants did not have internet access at home. Some participants reported being able to occasionally pickup Wi-Fi from neighbors or at relatives' homes. "For the application on the iPod you need internet in order to post it but I don't have access to internet that much so I couldn't post. I don't usually bring my iPod at school and don't have Wi-Fi at home." Others used public access: "Because I didn't really have a lot of internet, like in the library that I was getting Wi-Fi from, it's got like, it's getting remodel, so they tore it all down and they are still tearing it down, so there wasn't like a lot that I could do." The school also did not allow students to access Wi-Fi on campus. Later in the program, iN Touch researchers secured permission from the school to provide the Wi-Fi password to the iN Touch participants.

#### *3.6.2 Inconsistent tracking/other life priorities*

Participants indicated that they had not made ODL tracking a consistent habit. A few noted that they tended to do the same activities and eat the same foods so tracking repeatedly seemed redundant. Others said that a major schedule change such as the transition from school year to summer disrupted their routine. For example, one of the iN Touch participants started summer school and a summer job and found it difficult to pick it up again: "Um, kind of yeah, cause then as close as I was to TheCarrot, I kind of got separated from it because I had the summer job, so then it was kind of like I got detached from it. So then it got kind of hard to get back on track to TheCarrot. So it was like 8 weeks not being on TheCarrot, kind of was like Whoa." Still others found that unavoidable life events challenged them. "I was recording just plain activities and then automatically, after Grandpa passed away, about a week before that, I had stopped recording. Because I was at my Grandpa's house and I didn't have Wi-Fi there, cause they're not fancy with computers and all that, and they get mad at me when I bring out my phone and when I'm texting and all that, they get mad…" For one young person, the challenge was the competing priorities of motherhood and personal health. She said, "Cause going back and remembering…and then you got one baby here, 'Mommy, mommy' and one over here 'Mommy mommy,' it's like too much for me. For somebody else probably but for me it was too much."

#### *3.6.3 Future intentions*

A few participants indicated they would continue to use iN Touch for tracking ODLs even after the study was over. One participant said she would continue "Plugging in what I eat and what I exercise." Another reported that she would continue using the iN Touch application because it "is like a guide for me."

## 4 Discussion

The youth-centered, participatory design process identified a number of useful features and potential challenges to adoption and use. Although we cannot measure the avoidance of problems, we do interpret the qualitative findings and the usage and numerical ratings to assess whether the program fulfilled the recommended design and the technology was accepted by participants.

The iN Touch technology and health coaching intervention fulfilled the YAB recommended design elements. Indications of the positive impact of participatory design come from exit interviews in which participants expressed that the intervention fit their needs and they felt they were well supported during the study. In addition, technology acceptance as measured by usefulness, ease of use and use appears to have been quite good. The technology usefulness ratings were moderately high, and participants had many positive comments about the impact of the intervention on their awareness and ability to change behavior. Ease of use ratings were also quite high although there was also room for improvement. Participants recorded a large number of ODLs and several ODLs per day. The food tracker in particular was seen as the least usable tracker because the search function was cumbersome. Interestingly, the greatest percentage of ODLs recorded was of food. This may have been because individuals recorded multiple food items at each meal, whereas they might only record one mood or exercise item at a time. This may also indicate that participants were most interested in tracking food. The alternative of taking food pictures or describing the food consumed as a text entry into the journal was an attractive alternative to the participants.

The participants in this study represented a low-income, minority, urban population with limited experience with mobile technology. Even with this lack of familiarity, participants adopted the iPod Touch device and mobile application very quickly. There were very few support calls regarding the use of the device. The lack of Wi-Fi was anticipated as a challenge and was the most often cited barrier to use by participants. Although Wi-Fi might be available at certain locations, participants were not willing to go out of their way to connect. For this population, the

lack of Wi-Fi at home is likely to be a persistent barrier. Providing access to Wi-Fi at school is one strategy that might enhance use.

The challenges facing youth in this low-income community are many. Many worked part-time jobs in addition to going to school and fulfilling family responsibilities. Several had one or more children. Although we do not know the circumstances of all participants who failed to complete the study, we are aware of extreme personal challenges for some of them. Even with these challenges, the participants displayed excellent engagement in the study and used the technology extensively.

iN Touch was a design and feasibility study. The findings reported in this paper were limited to design and technology acceptance. Health outcomes are clearly an important indicator of effectiveness of the technology, and they will be reported in a future paper. There are several specific enhancements to iN Touch that may improve acceptance and use including improvement of food searching and recording. Future work should also look at the variety of other trackers that may have an impact on youth's self-management of overweight/obesity such as sleep, mindfulness and the potential of sharing of this individual data with other trusted, supportive individuals. Finally, implementation issues that stem from lack of ubiquitous connectivity will need to be addressed in future mobile health interventions. This is a challenge in the urban core as well as other low-resource environments such as rural and frontier communities where health disparities exist. Mobile application design will need to allow for local cache of application software and data with adequate safeguards for maintaining privacy.

This study was limited by a small sample selected by local providers and the lack of a control or comparison group. In addition, the attrition rate of 31.4 % was high although in the range or substantially less than many other youth obesity intervention studies. There are numerous potential differences between non-completer and completer participants. For example, if non-completers were less adept at technology, additional support may be needed to help them use the technology. If they are less motivated or ready to change their health, health coaching intervention strategies will also need to be adapted to make the use of technology appropriate to their needs. The findings reported should be interpreted with caution and may not be generalizable.

## 5 Conclusion

The iN Touch application is a promising tool for increasing awareness, seeing patterns of behavior, making behavior change and collecting data to be discussed with a health coach. Participants were highly engaged in the use of the application and felt that it offered a good tool for managing the behaviors that impact overweight/obesity. The results indicate that the use of a youth-centered, participatory design approach yielded a system that fit into the everyday lives of participants and contributed to positive outcomes on usefulness and ease of use. This project illustrated the importance of addressing the environmental context and needs of a specific target group for adoption, specifically the needs of low-income, urban minority youth.

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