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mHEALTH ACCEPTANCE AND USAGE AMONG SOUTH ASIAN ADULTS IN THE US

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE

OF DOCTOR OF PHILOSOPHY IN NURSING

THE UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT HOUSTON

CIZIK SCHOOL OF NURSING

BY

PADMAVATHY RAMASWAMY, Ph.D.(c), MPH, MSN, RN, FNP-C

December 2019

UTHealth
The University of Texas
Health Science Center at Houston

Cizik
School of Nursing

Approval Form D-3

10/16/2019
Date

To the Dean for the School of Nursing:

I am submitting a dissertation written by Padmavathy Ramaswamy and entitled "mHealth Acceptance and Usage among South Asian Adults living in the US." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Nursing.

Committee Chair

We have read this dissertation
and recommend its acceptance:

M.Sahiti

Accepted

Dean for the School of Nursing

Dedication

I dedicate this dissertation to my husband, Raja Raman, daughter, Prakriti Raman, my mother, Mrs. Lakshmi Ramaswamy and to my beloved father, late Mr. V.S. Ramaswamy who recently passed away. He was a source of encouragement and inspiration for me.

Acknowledgements

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Abstract

Padmavathy Ramaswamy, Ph.D.(c), MPH, MSN, RN, FNP-C

MHealth Acceptance and Usage among South Asian Adults in the US

December 2019

Background: Modifiable lifestyle factors such as physical inactivity and unhealthy diet contribute to the increased risk of cardiovascular diseases (CVD) and diabetes (DM) in South Asians (SAs). Interventions using mobile health (mHealth) have the potential to be of preventive and therapeutic value in reducing the burden of CVD and DM in SAs living in the US. However, there is a gap in knowledge regarding the usage and acceptance of mHealth among SAs.

Purpose: To examine the overall usage of mHealth and examine factors associated with the acceptance, usage, non-usage, and discontinuation of mHealth technology among SA adults living in the US.

Methods: The study utilized a cross-sectional design. A total of 134 SA adults were recruited to the study. Self-reported measures included demographics, health status, motivations for using mHealth, factors associated with technology acceptance and usage, reasons for non-usage and discontinuation of mHealth applications and smart and connected devices, using the survey developed by Paré, Leaver, & Bourget (2018). Correlation analyses were conducted using Pearson's correlation tests. Chi-square and Kruskal-Wallis analyses were conducted to compare group differences among current users, past users, and non-users of mHealth.

Results: About 62.4% of the participants were current users of mHealth applications, and 43.1% were current users of smart and connected devices. Users were between the ages 35-54 years, female, healthy, employed, university educated, with an annual family

income of over $80,000. There was a statistically significant difference in age (χ^2 (2) = 9.638, p = .007) and employment (χ^2 (4, N = 105) = 12.262, p = 0.019) between the current users, past users, and non-users of smart devices. Non-users of smart devices were more likely to be students, and between 18-34 years of age. The mean scores for the scales of perceived ease of use, perceived usefulness, confirmation of expectations, user satisfaction, and intent to continue using mHealth ranged from 3.5 – 4.2 (somewhat agree to strongly agree) for mHealth applications and from 4.1 to 4.4 (somewhat agree to strongly agree) for smart and connected devices.

Conclusions: mHealth technology was used and accepted by more than half of the surveyed South Asian adults. The results from this study may help in selecting and utilizing the most accepted mHealth technology for designing interventions for SA adults living in the US to lower the risk of CVD and DM.

*Keywords***:** South Asians, mHealth, technology acceptance

Table of Contents

Summary

The dissertation study entitled “MHealth Acceptance and Usage among South Asian Adults in the US” is presented in this book. The purpose of the study was to examine the overall usage of mobile health (mHealth) applications (apps) and smart and connected technology among South Asian adults living in the U.S.; and to examine factors associated with the acceptance, usage, and non-usage of mHealth technology in this population. This book includes the proposal of the study, the final manuscript describing the background, purpose, specific aims, conceptual framework, methods, statistical analyses, results, discussion, conclusions, and recommendations. The appendices contain the Institutional Review Board (IRB) approvals, consent forms, study flyers, instruments used for data collection, and the detailed study protocol. The curriculum vitae of the principal investigator is in the final section of the dissertation.

mHEALTH ACCEPTANCE AND USAGE AMONG SOUTH ASIAN ADULTS IN THE US

A DISSERTATION PROPOSAL

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN NURSING

THE UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT HOUSTON CIZIK SCHOOL OF NURSING

BY

PADMAVATHY RAMASWAMY, PhD (c), MPH, MSN, RN, FNP-C

DECEMBER 2018

Abstract

Background: South Asians (SAs) living in the United States have a higher risk for cardiovascular disease (CVD) and diabetes (DM) due to physical inactivity and unhealthy diet. Mobile health (mHealth) technologies including smartphone applications and wearable and connected devices have affect behavior change. Interventions using mHealth have demonstrated feasibility and potential efficacy for ethnic minorities such as Filipino Americans. However, there is a gap in knowledge regarding the usage and acceptance of mHealth among South Asians. The overall objectives of this study are to examine the overall usage of mHealth apps and wearable technology among SAs living in the US; and to examine factors associated with the acceptance, usage, and non-usage of mHealth technology in this population.

Research Design and Methods: This will be a cross-sectional study of SA adults above the age of 18 years old living in the US. A total of 134 participants will be recruited from religious, social, and community organizations in Houston central and suburban areas and from across US via e-mail and social media (Facebook, LinkedIn, WhatsApp) using convenience and snowball sampling. Data will be collected regarding demographics, health status, motivations for using mHealth, factors associated with technology acceptance and usage, reasons for non-usage and discontinuation of mHealth using the survey developed by Paré, Leaver, & Bourget (2018).

Data Analysis: Descriptive statistics will be used to calculate percentages and counts for categorical variables, and means and standard deviations for continuous variables. Pearson or Spearman correlation coefficient will be computed to examine correlation between the variables. Chi-square will be used to examine group differences.

Future Implications: Information regarding usage and acceptance of mHealth technology among SAs will help in designing effective interventions using these technologies.

Specific Aims

Health disparities exist among racial/ethnic populations, such as Latino and Asian American subgroups who suffer from higher rates of obesity, diabetes, and hypertension (Bender, Choi, Won, & Fukuoka, 2014). South Asians (SA) living in the United States (U.S.) have a higher risk for cardiovascular disease (CVD) and diabetes (DM) morbidity and mortality compared to other racial and ethnic groups (Talegawkar, Jin, Kandula, & Kanaya, 2017). Modifiable lifestyle factors such as physical inactivity and unhealthy diet contribute to this increased risk (Volgman et al., 2018).

Mobile health (mHealth) approaches, including smartphone applications and wearable and connected technology have been shown to be viable health behavior change intervention modalities for youth (Fedele et al., 2017), adults (Wang, Xue, Huang, Huang & Zhang, 2017), and in the management of chronic diseases (Lee, Choi, Lee & Jiang, 2018). Compared with standard diabetes care, app-based interventions have shown better improvements in glycemic control in patients with type 2 diabetes (Wu et al., 2018; Wu et al., 2017). Current evidence also shows benefits of mHealth in heart failure symptoms, reducing deaths and hospitalizations and improved quality of life (Marcolino et al., 2018). Empirical evidence is also beginning to emerge regarding the positive association between the use of exercise-related mobile technology and increase in physical activity (PA) levels (Direito, Carraca, Rawstorn, Whittaker, & Maddison, 2017; Litman et al., 2015). These technologies have the potential to be of both preventive and therapeutic value in reducing the burden of cardiovascular disease and diabetes in SA adults living in the US and in other countries. According to the Pew Research Center, 91% of English-speaking Asian Americans own a smartphone (Perrin, 2016). There are data on the

overall usage of smartphone apps, trackers and wearable technology among the general population in the U.S. (Nielsen, 2014), but data specific to SA adults living in the U.S. are lacking.

The primary reasons for adoption, barriers to adoption, factors influencing people's intention to use, and the reasons for usage discontinuation of mobile health apps, smart and connected health devices are largely unknown in the SA population. There is an urgent need to fill this gap in knowledge in order to provide culturally relevant information to users, health care providers, and researchers and help in developing effective interventions in the SA population using these technologies.

The long-term goal of the investigator is to decrease the risk of cardiovascular disease and diabetes among South Asians living in the US and improve the overall health of the SA population. The short-term goal is to design interventions to increase physical activity and improve diet using mobile health applications (apps) and wearable technology (wearables) tailored specifically to the needs of the SAs living in the US. In order to develop an intervention, we must first determine the overall usage of the apps and devices, so the *overall objectives* of this study are to (1) examine the overall usage of mHealth apps and wearable technology among SA adults living in the U.S.; and (2) to examine factors associated with the acceptance, usage, and non-usage of mHealth technology in this population. To accomplish the objective for this project, we will use a cross-sectional survey developed by Paré, Leaver, & Bourget (2018) in a sample of *South Asian adults living in the U.S.* by pursuing the following five specific aims:

Aim 1: To describe types and extent of mHealth technology (smartphone applications, wearable and connected health technology) ownership and usage among

current users. Aim 2**:** To describe factors related to the usage and non-usage of mHealth technology. Aim 3: To examine correlations among perceived ease of use (PEOU), perceived usefulness (PU), user satisfaction, confirmation of initial expectations, and intention to continue using mHealth technology among mHealth users. Aim 4: To describe the reasons for discontinuation of mHealth technology among past users. Aim 5: To examine group differences in age, gender, education, health status, country of origin and income among users, non-users, and past users of mHealth technology.

In the proposed study, our ***expected outcomes*** are to have identified and understood the extent of usage of mHealth technology and factors associated with usage and non-usage in a sample of South Asian adults living in the U.S. These results will have a ***positive impact*** because they will assist in designing interventions using mHealth technology in order to modify unhealthy behaviors in order to lower CVD risk in the SA population.

Research Strategy and Significance

Significance

Health disparities exist among racial/ethnic populations, such as Latino and Asian American subgroups who suffer from higher rates of obesity, diabetes, and hypertension (Bender et al., 2014). South Asians (SAs) (people from Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka) are disproportionately more affected by cardiovascular diseases (CVD) and Diabetes Mellitus (DM), compared to other groups such as Caucasians (Dodani, 2008; Talegawkar et al., 2017). Modifiable lifestyle factors such as physical inactivity and unhealthy diet contribute to this increased risk (Volgman et al., 2018). Physical inactivity is an independent risk factor for multiple diseases such as

diabetes and cardiovascular disease (Benderet al., 2014). South Asians tend to be physically inactive and less likely to meet the recommendations of the 2008 National Physical Activity guidelines, as compared to Whites (Bender et al., 2014; Kandula & Lauderdale, 2005). Similarly, dietary habits leading to higher rates of truncal obesity among South Asians (Volgman et al., 2018) also contribute to the higher incidence of DM and CVD in this population. Culturally tailored interventions targeting physical activity and diet have shown some success in the SA population (Volgman et al., 2018).

mHealth is defined as the delivery of healthcare services via mobile communication devices (Torgan, 2009). World health organization (WHO, 2011) has defined mHealth as medical and public health practice supported by mobile devices. mHealth use has the potential to overcome barriers to health care access, health information, and facilitate positive health outcomes (Bender et al., 2014). mHealth approaches including smartphone applications and wearable and connected technology have been shown to be viable health behavior change intervention modalities for youth (Fedele et al., 2017), adults (Wang et al., 2017) and in the management of chronic diseases (Lee et al., 2018). Compared with standard diabetes care, app-based mHealth interventions have shown to better improve glycemic control in patients with type 2 diabetes (Kitsiou, Pare, Jaana & Gerber, 2017; Wu et al., 2018; Wu et al., 2017). In the overview of systematic reviews by Kitsiou et al. (2017), mHealth interventions with clinical feedback were shown to improve glycemic control (HbA1c) compared to standard care or other non-mHealth approaches by as much as 0.3% in patients with type 2 diabetes, and 0.8% in type 2 diabetes. Current evidence also shows benefits of mHealth

in heart failure symptoms, reducing deaths and hospitalizations and improved quality of life (Marcolino et al., 2018).

Empirical evidence is beginning to emerge regarding the positive association between the use of exercise-related mobile technology and increase in physical activity (PA) levels (Direito et al., 2017; Litman et al., 2015). Mobile phone app interventions have shown to significantly reduce body weight by 1.04 kg and body mass index by 0.43 kg/m^2 in adults when compared with other control interventions (Flores-Mateo, Granado-Font, Ferre-Grau, & Montana-Carreras, 2015). Interventions using mHealth technology have demonstrated feasibility and potential efficacy for ethnic minorities such as Filipino Americans (Bender, Cooper, Flowers, Ma, & Arai, 2018).

Due to the convenience, affordability and the ubiquity of digital technologies, there is a high rate of smartphone ownership and use among racial/ethnic minorities (Bender et al., 2014). This evidence indicates the narrowing of the "digital divide" between racial/ethnic minorities and the general population. According to the Pew Research Center, 91% of English-speaking Asian Americans own a smartphone (Perrin, 2016). However, a knowledge gap exists in the sparse datasets describing mobile health and connected device use among racial/ethnic minority population (Bender et al., 2014). Surveys regarding health app use do not reflect the actual usage by the SAs living in the U.S. In a national survey conducted by Krebs and Duncan (2015) on a sample of 1604 mobile phone users, 7.11% (114/1604) of the participants were Asian-Americans. Although this survey had a good representation of the Asian population, they did not differentiate between the different subcategories. In another national survey conducted by Accenture on digital health, 66% of the 2301 participants were White, 12% Black, and

only 2% were Asians and Pacific Islanders (Accenture, 2016), with no further information about different categories of Asians. Disaggregated information is important to facilitate the design and development of lifestyle interventions using mHealth technology including applications (apps) and wearable technology in the SA population that is at higher risk for CVD and DM than other ethnic populations (Dodani, 2008; Talegawkar et al., 2017).

While mHealth technology such as smartphone apps and wearable trackers has many potential benefits, challenges are observed in the users' acceptance of these technologies (Zhang et al., 2017). High rates of attrition and low adherence are common among mHealth and e-health interventions, which may affect their impact (Bhalla, Durham, Al-Tabaa, & Yeager, 2016). Multiple factors have been attributed to low adherence and discontinuation of use of mHealth technology including poor design of technology, usability issues, lack of convenience and accessibility, lack of motivation, and user perceptions (Simblett et al., 2018; Tao, Shao, Liu, Wang, & Qu, 2016). Assessing user engagement and acceptability is important to understanding the overall impact, and explain variation in the outcomes (McCallum, Rooksby & Gray, 2018). However, studies exploring the primary reasons for adoption of smart and connected health devices, barriers to adoption; users' perceived benefits of these devices; factors influencing people's intention to continue using these technologies in the future, and the reasons for usage discontinuation are lacking in the South Asian population living in the United States. There is an urgent need to fill this gap in knowledge in order to provide culturally relevant information to users, health care providers, and researchers and help in developing effective interventions in this population using these technologies.

Conceptual Framework

The proposed research model for this study (Figure 1) adapted from Pare et al. (2018) has been derived from the Technology Acceptance Model (TAM) (Davis, 1989) and the Expectation-Confirmation theory of IS continuance (Bhattacharjee, 2001). Various models have been proposed for technology acceptance among users. The most widely used model is the Technology Acceptance Model (TAM) developed by Davis (1989). The TAM is a parsimonious model that explains much of the variance in users' behavioral intention related to information technology (IT) adoption and usage across a wide variety of contexts (Hong, Thong, Moon, & Tam, 2006; Taylor & Todd, 1995). The TAM is an intention-based model stipulating that the intention to adopt a technology is a good predictor of its actual usage (Hong, Thong, & Tam, 2006). In the TAM, the main explanatory variables of users' intention to adopt a behavior are perceived usefulness and perceived ease of use. Perceived usefulness is an individual's perception that a new technology can help improve one's activity goal (Venkatesh, Morris, Davis, & Davis, 2003). Perceived ease of use is defined as the degree to which the user expects that the use of a new technology will require minimal effort (Venkatesh et al., 2003). Previous research has also shown the influence of user satisfaction on an individual's intention to use or continue using a certain technology (Bhattacharjee, 2001, Hong, Thong, & Tam, 2006). User satisfaction is a construct of the Expectation-Confirmation theory where satisfaction is viewed as the key to building and retaining long-term customers (Bhattacharjee, 2001). Satisfaction is defined by the International Organization for Standardization (ISO) 9241-11 standard as the positive associations and absence of discontent that the user experiences (Georgsson & Staggers, 2015). The central construct

of the Theory of Planned Behavior (TPB) is the person's intention to engage in a particular behavior (Azjen, 1991). Behavior intention or intent to use is defined as a person's perceived likelihood or "subjective probability that he or she will engage in a given behavior" ("IOM Committee on communication", 2002, p.31). Confirmation of Initial Expectations is a construct from the Expectation-Confirmation Model of IS continuance. This theory explains that when expectations are positively confirmed via user experience, they can influence perceived usefulness and user satisfaction, which increases the intentions of continued use (Bhattacherjee, 2001). Studies using this paradigm posit that consumer satisfaction decisions are determined by initial expectations on a product, and discrepancies between expectations and product performance (Hong, Thong, & Tam, 2006).

The proposed research model for this study (Figure 1) suggests that an individual's intention to continue using smartphone apps and wearable technology is associated with the perceived usefulness, perceived ease of use, confirmation of initial expectations and user satisfaction. The model assumes that an individual's intention to use/continue using is a good predictor of actual usage of mHealth technology in the SA population based on previous research (Turner, Kitchenham, Brereton, Charters, & Budgen, 2010).

Innovation

The proposed study is innovative in that it seeks to investigate the usage and user acceptance factors associated with the acceptance of mHealth technology in a population that is at high-risk for CVD. This is the first study of its kind in the South Asian population living in the United States. Data obtained from this study may provide

important information that is necessary to design innovative interventions for different ethnic populations. Our study will be among the first to utilize the constructs of TAM, and Expectation-Confirmation theory study mHealth user acceptance in SA adults living in the U.S.

Approach

Using a cross-sectional survey design on a study sample of South Asian adults living in the United States, we propose to examine and describe the types and extent of mHealth technology among users (Aim 1). We also propose to describe factors on the usage and non-usage of mHealth technology in South-Asian adults living in the United States (Aim 2), to examine correlations among PEOU, PU, user satisfaction, confirmation of initial expectations and intention to continue using mHealth technology among users (Aim 3), to describe the reasons for discontinuation of these technologies among past users (Aim 4), and to examine group differences in age, gender, education, health status, country of origin and income among users, non-users, and past users of mHealth technology (Aim 5). The study sample will be recruited from community organizations in the Houston central and suburban areas and also online through social media such as Facebook, WhatsApp, and LinkedIn throughout the United States.

Sample and setting.

A convenience and snowball sampling technique will be used to recruit the study subjects. In the study by Pare et al. (2018), the smallest correlation coefficient between subscales was $r = 0.53$. Based on a sample size of $n = 29$, a Pearson correlation coefficient will have 80% power when the effect size is $r = 0.5$. Assuming there are equal number of respondents in each of the 3 groups (non-users, past users, and current users),

3 times the sample size of users will be enrolled. Therefore, the sample required is 87. To ensure our study will achieve 80% power and to account for missing data, we will enroll 100 participants.

South Asian adults over the age of 18 years will be recruited from religious, social and community organizations within the South Asian community living in the Houston central and suburban areas. The study investigator will contact community leaders of each subgroup of the target population, and seek the support of these community leaders. Flyers will be posted at the community and religious organizations after seeking permission from the community leaders. The flyer will provide a brief description of the study and contact information via e-mail. In addition, the community leaders will be provided with a link to the survey that they can distribute electronically to the community members through mass e-mails or listservs. Recruitment will also take place using paper surveys in medical clinics primarily serving SA populations, community health fairs and other culturally relevant events such as the Houston Diwali Mela 2018. Recruitment will also take place via social media including Facebook, WhatsApp, and LinkedIn. The link to the surveys on Facebook will be posted on the principal investigator's (PI) Facebook page which will be created specifically for this project and will be shared with the groups consisting of South Asians. Snowball sampling will take place with sharing of the links via Facebook, WhatsApp, and LinkedIn. A link to the survey will be forwarded via WhatsApp and e-mail to community leaders and other contacts of the principal investigator requesting them to share it with individuals of South Asian origin living in the United States. A link to the survey will be posted on the PI's LinkedIn page requesting contacts to share and post on their pages. Inclusion criteria: South Asian adults

above the age of 18 years who self-identify as South Asians (with origins from India, Pakistan, Sri Lanka, Bangladesh, Bhutan, and Nepal).

Data collection.

Testing of the survey instrument will be done with the first 10 participants. This is done to ensure the accuracy of data entry and coding system and also to check if the participants are entering the information correctly. Further recruitment and data collection will resume after checking the results of the pilot testing. For in-person data collection, the participants will be given written informed consent to read after their eligibility has been established. The PI will review the content with the participants emphasizing that the information the participant provides will be confidential and used for research purposes only. After consent to study participation has been provided, the participants will be given the paper survey to complete. For those completing the survey online, a link to the survey using Qualtrics online survey software will be e-mailed to the participants recruited through community leaders or shared via social media. The link to the survey will initially open with eligibility questions regarding South Asian descent and age. If eligible, this will be followed by the opening page of the survey which will explain the purpose of the survey, and participants will be given access to the survey only after they have accepted and acknowledge reading the information. Participants' completion of survey will indicate implied consent.

Incentives for online and on-site survey completion will include a chance to win one $100 Amazon gift card. Online and on-site participants who are interested in entering the drawing for the gift card will be asked to provide their name and contact information including e-mail and phone number. Winner will be drawn by the investigator after the

recruitment has been completed and an electronic gift card will be mailed either electronically or via mail. The names of the participants will be entered in an Excel spreadsheet, and using the random number function, each participant will be assigned a random number. The person with the highest number will be chosen as the winner of the gift card.

Measurements.

All data will be collected using the survey by Pare et al (2018).

Demographic information: Demographic data including age, gender, education, income, country of origin, and use of mobile phones and digital tablets will be assessed by standard survey items administered in other international surveys and by Pare et al. (2018).

Health status: Overall health status will be obtained by asking participants to self-rate their own health on a scale of 1=poor to 5=very good or excellent. This single-item measures represents a valid and acceptable measure (Bowling, 2005). Question whether participants had one or more of the following chronic condition will also be included: (1) diabetes, (2) High blood pressure, (3) obesity, (4) cardiovascular disease, (5) lung or respiratory airway disease, (6) cancer, (7) bone or muscular disease, (8), disease of nervous system, (9) mental disorder, (10) chronic infectious disease, and (11) addiction to tobacco or drugs.

Familiarity with connected care technologies and frequency of use of these technologies will be measured using survey questions used by Pare et al. (2018). **Motivations** for using mHealth self-tracking devices will be measured with the 10-item scale developed by Pare et al. (2018). **Data-sharing** behaviors will be assessed using a

single item asking “Do you ever share with other people the data stored in your device or mobile app?”

Technology acceptance and appreciation: Table 1 describes the measurements and scales for the variables. **Reasons for non-usage** will be assessed using a 10-item checklist of reasons (Pare et al., 2018). **Reasons for stopping usage** will be assessed using a 10-item checklist (Pare et al., 2018).

Data Analysis

Statistical analyses will be performed using IBM SPSS for Windows version 25 (IBM Corp., NY). Preliminary assumption testing will be done for normality and linearity. Descriptive statistics (mean, standard deviation (SD), percentage) will be produced for all the key variables and socio-demographics including the number of participants, age, gender, education, income, country of origin, and type. Based on the responses, the participants will be categorized into 3 groups: non-users, past users, and current users.

Aim 1: To describe types and extent of mHealth technology (smartphone applications, wearable and connected health technology) ownership and usage among current users. Descriptive statistics (mean, SD, percentage) will be produced for type, frequency, and length of use of smartphone applications and wearable devices used.

Aim 2**:** To describe factors related to the usage and non-usage of mHealth technology. Descriptive statistics (mean, SD, percentage) will be produced for the various factors of non-use among non-users. Descriptive statistics (mean, SD, percentage) will be produced for the various motivations of use among users of mHealth.

Aim 3: To examine correlations among PEOU, PU, user satisfaction, confirmation of initial expectations and intention to continue using mHealth technology among users. Pearson correlation coefficients will be used to examine the correlations between PEOU, PU, user satisfaction, confirmation of initial expectations and intention to continue using mHealth technology. If the data are found to not follow normal distribution, then a non-parametric Spearman correlation coefficient will be used.

Aim 4: To describe the reasons for discontinuation of mHealth technology among past users. Descriptive statistics (mean, SD, percentage) will be produced for the reasons of discontinuation of mHealth technology.

Aim 5: To examine group differences in age, gender, education, health status, country of origin and income among users, non-users, and past users of mHealth technology. Chi square used to compare gender and country of origin by group. Kruskal-Wallis test will be used to compare age, health status, education and income level between the groups.

Reliability estimates of the instruments will be computed with Cronbach's alpha. A coefficient alpha $\geq .70$ will be considered acceptable for internal consistency reliability (DeVellis, 2003).

Potential pitfalls and alternative strategies.

If statistical assumptions are violated, data transformations or alternate statistical methods such as nonparametric statistics will be used as possible. Missing data is a possible pitfall. Strategies to address missing data will be employed as appropriate (e.g., imputation). Case mean substitution technique will be utilized for imputing item-level missingness (Fox-Wasylyshyn & El-Masri, 2005).

Human subjects.

The risk to the subjects is minimal. Informed consent will be signed or implied for online surveys by the participants and participation will be voluntary. There is a theoretical risk of breach of confidentiality. However, the data supplied by the participants will be coded and identified by ID number only, and will be stored in computer files that are protected by passwords known only to the PI. IRB approval will be sought before data collection begins.

All collected data will remain with the investigators, and stored with the master list of subject ID codes in a locked file cabinet in SON Room 784 at the University of Texas Health Science Center at Houston, Cizik School of Nursing. Responses to the paper survey will be entered into Qualtrics manually and imported into SPSS statistical software (SPSS Inc., Chicago, IL). The responses to the online survey completed via Qualtrics will be directly exported to SPSS statistical software. Accuracy of data entry will be double checked against the original participant questionnaires.

Although there are no direct benefits from participation in this study, results of this study will provide information on the factors of usage and discontinuation of mHealth technology among South Asian adults living in the U.S. This will inform providers and researchers in designing interventions using mHealth technology. Intervention designs that take into consideration the individual acceptance factors will be more effective and keep the participants engaged. This will help reduce the overall burden of CVD and other metabolic diseases in this population.

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mHEALTH ACCEPTANCE AND USAGE AMONG SOUTH ASIAN ADULTS IN THE US

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN NURSING

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Abstract

Background: Modifiable lifestyle factors such as physical inactivity and unhealthy diet contribute to the increased risk of cardiovascular diseases (CVD) and diabetes (DM) in South Asians (SAs) (Volgman et al., 2018). Interventions using mobile health (mHealth) have demonstrated feasibility and potential efficacy for ethnic minorities (Bender et al., 2018), and have the potential to be of preventive and therapeutic value in reducing the burden of CVD and DM in SAs living in the US. However, there is a gap in knowledge regarding the usage and acceptance of mHealth among SAs. **Purpose**: The objectives were to examine the overall usage of mHealth and examine factors associated with the acceptance, usage, non-usage, and discontinuation of mHealth technology among SA adults living in the US. **Methods**: The study utilized a cross-sectional research design. A total of 134 South Asian adults were recruited to the study. Self-reported measures included demographics, health status, motivations for using mHealth, factors associated with technology acceptance and usage, reasons for non-usage and discontinuation of mHealth applications (apps) and smart and connected devices using the survey developed by Paré, Leaver, & Bourget (2018). Correlation analyses were conducted using Pearson's and Spearman's correlation tests. Chi-square and Kruskal-Wallis analyses were conducted to compare group differences among current users, past users, and non-users of mHealth technology. **Results**: About 62.4% of the participants were current users of mobile health apps, and 43.1% were current users of smart and connected devices. Users were on an average between the ages 35-54 years, female, healthy, employed, university educated, with an annual family income of over $80,000. There was a statistically significant difference in age (χ^2 (2) = 9.638, p = .007) and employment (χ^2 (4, N = 105) =

12.262, $p = 0.019$) between the current users, past users, and non-users of smart devices. Non-users of smart devices were more likely to be students, and between 18-34 years of age. The mean scores for the scales of perceived ease of use, perceived usefulness, confirmation of expectations, user satisfaction, and intent to continue using mHealth technology ranged from 3.5 – 4.2 (somewhat agree to strongly agree) for mobile health apps and from 4.1 to 4.4 (somewhat agree to strongly agree) for smart and connected devices. **Conclusions**: mHealth technology was used, accepted, and appreciated by more than half of the South Asian adults that we surveyed. The results from this study may help in selecting and utilizing the most accepted mHealth technology for designing interventions for South Asian adults living in the US to lower the risk of CVD and DM.

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Advances in healthcare technology, including mobile health (mHealth) are providing various benefits to today's healthcare consumer. Mobile-based technology is increasingly becoming a part of everyday lives. It is estimated that almost 2 billion people in the world own a smartphone providing them access to a variety of applications (Mcmillan, Kirk, Hewitt, & MacRury, 2016). The number of connected wearable devices worldwide is expected to jump from an estimate of 325 million in 2016 to over 830 million in 2020 (Statista, 2018). Increased availability of mobile technology, increased affordability and access, and the convenience of these devices have fueled the growth of mobile health apps (Birkhoff & Smeltzer, 2017; Varshney, 2014) and wearable devices. However, it is important to know the acceptance and usage of these technologies among consumers of different racial and ethnic populations in order to bridge the digital gap and to inform the potential utility of this method of intervention dissemination.

Background

Health disparities exist among racial/ethnic populations, such as Latino and Asian American subgroups who suffer from higher rates of obesity, diabetes, and hypertension (Bender et al., 2014). South Asians (SAs) (people from Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka) are disproportionately more affected by cardiovascular diseases (CVD) and Diabetes Mellitus (DM), compared to other groups such as Caucasians (Dodani, 2008; Talegawkar et al., 2017). Modifiable lifestyle factors such as physical inactivity and unhealthy diet contribute to this increased risk (Volgman et al., 2018). Physical inactivity is an independent risk factor for multiple diseases such as diabetes and cardiovascular disease (Bender et al., 2014). South Asians tend to be physically inactive and less likely to meet the recommendations of the 2008 National

Physical Activity guidelines, as compared to Whites (Bender et al., 2014; Kandula & Lauderdale, 2005). Similarly, dietary habits leading to higher rates of truncal obesity among South Asians (Volgman et al., 2018) also contribute to the higher incidence of DM and CVD in this population. Culturally tailored interventions targeting physical activity and diet have shown some success in the SA population (Volgman et al., 2018).

mHealth is defined as the delivery of healthcare services via mobile communication devices (Torgan, 2009). World health organization (WHO, 2011) has defined mHealth as medical and public health practice supported by mobile devices. mHealth use has the potential to overcome barriers to health care access, health information, and facilitate positive health outcomes (Bender et al., 2014). mHealth approaches including smartphone applications and wearable and connected technology have been shown to be viable health behavior change intervention modalities for youth (Fedele et al., 2017), adults (Wang et al., 2017) and in the management of chronic diseases (Lee et al., 2018). Compared with standard diabetes care, app-based mHealth interventions have shown to better improve glycemic control in patients with type 2 diabetes (Kitsiou, Pare, Jaana & Gerber, 2017; Wu et al., 2018; Wu et al., 2017). In a systematic review by Kitsiou et al. (2017), mHealth interventions with clinical feedback were shown to improve glycemic control (HbA1c) compared to standard care or other non-mHealth approaches by as much as 0.8% in type 2 diabetes. Current evidence also shows that mHealth approaches can reduce deaths and hospitalizations and improve quality of life in heart failure patients (Marcolino et al., 2018).

Empirical evidence is beginning to emerge regarding the positive association between the use of exercise-related mobile technology and increase in physical activity (PA) levels

among adults (Direito et al., 2017; Litman et al., 2015). Mobile phone app interventions have contributed to significant reduction in body weight by 1.04 kg and body mass index by 0.43 kg/m² in adults when compared with other control interventions (Flores-Mateo, Granado-Font, Ferre-Grau, & Montana-Carreras, 2015). Interventions using mHealth technology have also demonstrated feasibility and potential efficacy for ethnic minorities such as Filipino Americans (Bender, Cooper, Flowers, Ma, & Arai, 2018).

Due to the convenience, affordability and the ubiquity of digital technologies, there is a high rate of smartphone ownership and use among racial/ethnic minorities (Bender et al., 2014). This evidence indicates the narrowing of the "digital divide" between racial/ethnic minorities and the general population. According to the Pew Research Center, 91% of English-speaking Asian Americans own a smartphone (Perrin, 2016). However, a knowledge gap exists in the sparse datasets describing mHealth and connected device use among racial/ethnic minority population (Bender et al., 2014). Surveys regarding health app use do not reflect the actual usage by the SAs living in the U.S. In a national survey conducted by Krebs and Duncan (2015) on a sample of 1604 mobile phone users, 7.11% (114/1604) of the participants were Asian-Americans. Although this survey had a good representation of the Asian population, they did not differentiate between the different subcategories. In another national survey conducted by Accenture on digital health, 66% of the 2301 participants were White, 12% Black, and only 2% were Asians and Pacific Islanders (Accenture, 2016), with no further information about different categories of Asians. Disaggregated information is important to facilitate the design and development of lifestyle interventions using mHealth technology including applications (apps) and wearable technology in the SA population

that is at higher risk for CVD and DM than other ethnic populations (Dodani, 2008; Talegawkar et al., 2017).

While mHealth technology such as smartphone apps and wearable trackers has many potential benefits, challenges are observed in the users' acceptance of these technologies (Zhang et al., 2017). High rates of attrition and low adherence are common among mHealth and e-health interventions, which may affect their impact (Bhalla, Durham, Al-Tabaa, & Yeager, 2016). Multiple factors have been attributed to low adherence and discontinuation of use of mHealth technology including poor design of technology, usability issues, lack of convenience and accessibility, lack of motivation, and user perceptions regarding the technology (Simblett et al., 2018; Tao, Shao, Liu, Wang, & Qu, 2016). Assessing user engagement and acceptability is important to understanding the overall impact, and to explain variation in the outcomes (McCallum, Rooksby & Gray, 2018). However, studies exploring the primary reasons for adoption of smart and connected health devices, barriers to adoption, users' perceived benefits of these devices; factors influencing people's intention to continue using these technologies in the future, and the reasons for usage discontinuation, are lacking in the South Asian population living in the United States.

There is an urgent need to fill this gap in knowledge in order to determine if this modality shows promise among SAs and assess the barriers and facilitators that may impact intervention design. This knowledge will also help in providing culturally relevant information to users, health care providers, and researchers and help in developing effective interventions in the SA population using these technologies.

Purpose

The purpose of this cross-sectional study was to examine the overall usage of mHealth apps and wearable technology among SA adults living in the US; and to examine the factors associated with the acceptance, usage and non-usage of mHealth technology in this population. The primary reasons for adoption, barriers to adoption, factors influencing people's intention to use, reasons for discontinuation usage of mHealth apps, and smart and connected devices are largely unknown in the SA population. The findings of this study fill this gap in knowledge in order to provide culturally relevant information to users, health care providers, and researchers to inform development of effective interventions in the SA population using these technologies.

Specific Aims

To accomplish the objective for this project, a cross-sectional survey developed by Paré, Leaver, & Bourget (2018) was used in a sample of South Asian adults living in the U.S. by pursuing the following five specific aims:

1) To describe types and extent of mHealth technology (smartphone applications, wearable and connected health technology) ownership and usage among current users.

2) To describe factors related to the usage and non-usage of mHealth technology.

3) To examine correlations among perceived ease of use (PEOU), perceived usefulness (PU), user satisfaction, confirmation of initial expectations and intention to continue using mHealth technology among mHealth users.

4) To describe the reasons for discontinuation of mHealth technology among past users.

5) To examine group differences in age, gender, education, health status, country

of origin and income among users, non-users, and past users of mHealth technology.

The expected outcomes of this study were to identify and understand the extent of usage mHealth technology and factors associated with usage and non-usage in a sample of SA adults living in the US.

Conceptual Framework

The proposed research model for this study (Figure 1) adapted from Pare et al. (2018) has been derived from the Technology Acceptance Model (TAM) (Davis, 1989) and the Expectation-Confirmation theory of IS continuance (Bhattacharjee, 2001). Various models have been proposed for technology acceptance among users. The most widely used model is the Technology Acceptance Model (TAM) developed by Davis (1989). The TAM is a parsimonious model that explains much of the variance in users' behavioral intention related to information technology (IT) adoption and usage across a wide variety of contexts (Hong, Thong, Moon, & Tam, 2006; Taylor & Todd, 1995). The TAM is an intention-based model stipulating that the intention to adopt a technology is a good predictor of its actual usage (Hong, Thong, & Tam, 2006). In the TAM, the main explanatory variables of users' intention to adopt a behavior are perceived usefulness and perceived ease of use. Perceived usefulness (PU) is an individual's perception that a new technology can help improve one's activity goal (Venkatesh, Morris, Davis, & Davis, 2003). Perceived ease of use (PEOU) is defined as the degree to which the user expects that the use of a new technology will require minimal effort (Venkatesh et al., 2003). Previous research has also shown the influence of user satisfaction on an individual's intention to use or continue using a certain technology (Bhattacharjee, 2001, Hong, Thong, & Tam, 2006). User satisfaction is a construct of the Expectation-Confirmation

theory where satisfaction is viewed as the key to building and retaining long-term customers (Bhattacharjee, 2001). Satisfaction is defined by the International Organization for Standardization (ISO) 9241-11 standard as the positive associations and absence of discontent that the user experiences (Georgsson & Staggers, 2016). The central construct of the Theory of Planned Behavior (TPB) is the person's intention to engage in a particular behavior (Azjen, 1991). Confirmation of Initial Expectations is a construct from the Expectation-Confirmation Model of IS continuance. This theory explains that when expectations are positively confirmed via user experience, they can influence perceived usefulness and user satisfaction, which increases the intentions of continued use (Bhattacherjee, 2001). Studies using this paradigm posit that consumer satisfaction decisions are determined by initial expectations on a product, and discrepancies between expectations and product performance (Hong, Thong, & Tam, 2006). Behavior intention or intent to use is defined as a person's perceived likelihood or "subjective probability that he or she will engage in a given behavior" ("IOM Committee on communication", 2002, p.31). Continued usage of information technology (IT), according to the Expectation-Confirmation model is predicted by user satisfaction with the product; extent of user confirmation; and post-adoption expectations, represented by perceived usefulness (Bhattacherjee, 2001; Hong, Thong, & Tam, 2006).

The proposed research model for this study suggests that an individual's intention to continue using smartphone apps and wearable technology is associated with the perceived usefulness, perceived ease of use, confirmation of initial expectations and user satisfaction. The model assumes that an individual's intention to use/continue using is a

good predictor of actual usage of mHealth technology in the SA population based on previous research (Turner, Kitchenham, Brereton, Charters, & Budgen, 2010).

Methods

This study utilized a cross-sectional research design. Data regarding demographics, health status, motivations for using mHealth, factors associated with technology acceptance and usage, reasons for non-usage and discontinuation of mHealth apps and smart and connected devices was collected using the survey developed by Paré, Leaver, & Bourget (2018) on a sample of SA adults living in the US. The study was completed under the supervision of the faculty at the University of Texas Health Science Center at Houston (UTHealth), Cizik School of Nursing. The study was granted full Institutional Review Board (IRB) approval from UTHealth under an exempt status (Appendix A).

Participants

Inclusion criteria for the study were as follows: (a) South Asian adults 18 years of age and older who self-identify as South Asians (with origins from India, Pakistan, Sri Lanka, Bangladesh, Bhutan, and Nepal) living in the United States; (b) able to read and write English; and (c) willing to participate in the study.

To calculate the sample size, a power analysis was conducted using G*Power software (Version 3.1.9.2). In the study by Pare et al. (2018), the smallest correlation coefficient between subscales was $r = 0.53$. Based on a sample size of $n = 29$, a Pearson correlation coefficient would have 80% power when the effect size is $r = 0.5$. Assuming there would be equal number of respondents in each of the 3 groups (non-users, past users, and current users), 3 times the sample size of users would have to be enrolled.

Therefore, the sample required was 87. To ensure the study will achieve 80% power and to account for missing data, the enrollment goal of the study was estimated at 100 total subjects. During the survey period, 134 eligible participants took the survey, and IRB approval was obtained for 134 subjects (Appendix F) .

A total of 200 subjects were approached and invited to participate via e-mail, and social media such as WhatsApp, Facebook, and LinkedIn. A link to the Qualtrics survey was sent to the subjects via these social media platforms or e-mail, if provided by the participants who responded to the flyers, or social media messages. Of the 167 participants who accessed the survey, 134 were eligible and thus comprised the sample size in the study. Thirty-three potential subjects were excluded for various reasons including not giving consent for the study not being South Asian, and not being 18 years of age or older. The study sample was collected using a nonprobability convenience and snowball sampling technique.

Procedure

Study flyers (Appendix B) were posted on university campuses and social and community organizations serving SAs following IRB approval. Participants were also approached via social media, mainly Facebook and WhatsApp. A link to the Qualtrics survey was posted on the researcher's Facebook page and shared among Facebook groups consisting of South Asians. Snowball sampling was conducted with sharing of the flyers via WhatsApp, Facebook, LinkedIn, and e-mail. Subjects were contacted by the researcher and the link to the survey sent to them via one of the above-stated media. No paper surveys were distributed. Survey respondents were able to enter the survey at any point during the data collection period from March 13, 2019 to May 9, 2019. The

respondents who partially completed the survey were able to exit and return at a later date to enter additional data for up to 30 days. Testing of the survey instruments was done with the first 10 participants to ensure the accuracy of data entry and coding systems and also to check if the participants entered the information in the appropriate fields. Further recruitment and data collection resumed after checking the results of the initial testing of the instrument.

Participants who took the survey were given an option to enter a drawing to win $100 gift card. The e-mail addresses of the respondents who entered the drawing were collected with a different Qualtrics survey which was not linked to the study survey. The participants who opted to receive the gift card were provided a link to the different Qualtrics survey for gift card. The names of the participants were entered in an Excel Spreadsheet, and using the random number function, each participant was assigned a random number. The person with the highest number was chosen as the winner of the gift card. The winner was drawn by the investigator after the recruitment was completed and an electronic gift card was mailed to the winning participant.

Measures and Instruments

The survey instrument developed by Pare et al. (2018) was used in the study with permission from the authors and with modifications made in the demographic questions for the South Asian sample.

Demographic and Clinical Information Questionnaire. Gender, age, gross family income, education level, occupation, and use of mobile phones and digital tablets were assessed using the survey items developed by Pare et al. (2018). Country of birth

and languages spoken were assessed using the survey items administered in other studies conducted on South Asians (Gor et al., 2015)

Overall Health Status was obtained by a single-item measure where the participants were asked to self-rate their own health on a scale from 1= very poor to 5 = excellent. This single-item measure represents a valid and acceptable measure (Bowling, 2005). Participants were also asked whether they had one of the following chronic conditions: 1) diabetes, 2) high blood pressure, 3) obesity, 4) heart disease, 5) lung or respiratory disease, 6) cancer, 7) bone or muscle disease, 8) disease of the nervous system, 9) mental disorders, 10) chronic infectious disease, and 11) addiction to tobacco, drugs or alcohol.

Ownership and Familiarity with Smart and Connected Devices. Familiarity with smart and connected devices was measured with the question, "How familiar are you with smart devices for health and well-being?" using a 5-point Likert scale, where 1 = "not much at all" to 5 = "extremely". The ownership of smart and connected care devices was assessed with a list of 13 specific non-branded devices commonly available in the US and Canada (Pare et al., 2018). For each device owned, the participants were asked the frequency of use using a 7-point scale, where 1 = once a month or less to 7 = many times a day.

Motivations for Using Mobile Health Apps. The motivations for using apps were measured with 10 items developed by Pare et al., 2018 using a 5-point Likert scale, where 1 = not at all and 5 = very strongly. The items for this scale were derived from prior surveys on consumer digital health (Pare et al., 2018). Examples of motivations for use, include "know myself better and monitor changes in things I consider important for

my health", "break a bad habit related to my health", "give me daily encouragement" and "improve communication with my physician or health professional".

Data Sharing was assessed using a single-item question, "Do you ever share the data on health and well-being recorded in your apps with other people?" If yes, respondents were asked to select with whom they choose to share the data. Examples include family members, friends, family doctor, nurse, pharmacist or personal trainer.

Acceptance of Apps and Smart and Connected devices. Respondents' acceptance of mobile health apps and smart and connected devices were assessed with five variables/constructs. Perceived ease of use (PEOU) and perceived usefulness (PU) are constructs from the Technology Acceptance Model (Davis, 1989) and the measures were adapted by Pare et al. (2018) and used in this study. User satisfaction, confirmation of initial expectations, and intention to continue using wearables and smart devices were adapted from Bhattacherjee (2001) and Hong et al. (2006) by Pare et al. (2018) and used in this study with permission.

Perceived Ease of Use (PEOU) was measured on a 5-point Likert scale where 1 = strongly disagree to 5 = strongly agree. The scale consists of 4 items. PEOU was measured among the users of apps and users of wearables and smart devices. An example of a question for app users was "learning how to use my app(s) was easy". An example of a question for users of wearables and smart device was "learning how to use my smart device(s) for health was easy". To compute the score of perceived ease of use, the mean of all the answered items on the total scale was calculated, with higher scores indicating better perceived ease of use of apps and wearables and smart devices respectively.

Perceived Usefulness (PU) was measured on a 5-point Likert scale where 1 = strongly disagree to 5 = strongly agree. The scale consists of 7 items. PU was measured among the app users and users of smart and connected devices. An example of a question for app users was “I have maintained or improved my health status by using apps”. An example of a question for users of smart and connected devices was “I have maintained or improved my health status by using smart device(s) for health”. To compute the score for PU, the mean of all the answered items on the total scale was calculated, with higher scores indicating better perceived usefulness of apps and wearables and smart devices respectively. The constructs of PEOU and PU have been used and measured in numerous studies and have consistently shown satisfactory internal consistency reliability in different populations and also for different technologies (Turner et al., 2010).

User Satisfaction was measured on a 5-point Likert scale where 1 = strongly disagree to 5 = strongly agree. The scale consists of 3 items. User satisfaction was measured among the app users and users of smart and connected devices. An example of a question for app users was “I am satisfied with my use of apps”. An example of a question for users of smart and connected devices was “I am satisfied with the use I am making of my smart device(s) for health”. To compute the score for user satisfaction, the mean of all the answered items on the total scale was calculated, with higher scores indicating better user satisfaction of apps and wearables and smart devices respectively.

Confirmation of Initial Expectations was measured on a 5-point Likert scale where 1 = strongly disagree to 5 = strongly agree among the app users and users of smart and connected devices. An example of a question for app users was “Using my app(s) turned out to be easier than I first thought”. An example of a question for users of smart

and connected devices was “Using my smart device(s) for health turned out to be easier than I first thought”. To compute the score for confirmation of initial expectations, the mean of all the answered items on the total scale was calculated, with higher scores indicating better confirmation of initial expectations of apps and wearables and smart devices respectively.

Intention to Continue Usage was measured on a 5-point Likert scale where 1 = strongly disagree to 5 = strongly agree among the app users and users of smart and connected devices. An example of a question for app users was “I have every intention of continuing to use health app(s) in the future”. An example of a question for users of smart and connected devices was “I have every intention of continuing to use my smart device(s) for health in the future”. To compute the score for intention to continue usage, the mean of all the answered items on the total scale was calculated, with higher scores indicating better intention to continue usage of apps and wearables and smart devices respectively.

In the study by Pare et al. (2018), PEOU, PU, confirmation of initial expectations, user satisfaction and intention to continue usage were tested for internal consistency reliability with Cronbach’s alpha statistics and demonstrated satisfactory internal consistency reliability (Table 1).

Reasons for Non-usage and for Discontinuing usage. The list of 10 questions developed by Pare et al. (2018) about reasons for non-usage were administered to only those respondents who had indicated that they either do not use mobile health apps or devices. The respondents checked only those items that were applicable to their personal situation. A list of 11 items developed by Pare et al. (2018) was administered to assess

the reasons why consumers stopped using their smart devices. Both lists were developed by Pare et al. (2018) with items derived from prior surveys on consumer digital health.

Statistical Analysis

Statistical analyses were performed by the researcher using the IBM SPSS Statistics software, version 25 (SPSS Inc., Chicago, IL, USA). Univariate outliers and statistical assumptions were checked prior to analysis. Continuous variables were checked for normal distribution.

Descriptive statistics were reported for the total sample (N=134). Frequencies and percentages were reported for categorical variables. Percentages were not calculated or reported for non-respondents or those respondents who preferred not to answer. The sample was categorized into current users, past users and non-users of apps and wearables and smart devices. Frequencies and percentages were calculated for each of those categories.

General trends regarding the ownership and use of connected care technologies were analyzed with descriptive statistics (frequencies and percentages). Descriptive statistics (frequencies and percentages) were also reported for the reasons for discontinuation and non-usage of connected care technologies.

Pearson correlation coefficients were used to examine the correlations between the instrument scores (PEOU, PU, user satisfaction, confirmation of initial expectations and intention to continue usage) measuring the user acceptance of connected care technologies (apps and wearables). Chi square tests were used to compare gender and country of origin, occupation and chronic diseases while the Kruskal-Wallis test was used

to compare age, gross family income, perceived health status, and education among the current users, past users and non-users.

Missing data analysis was done using Little's MCAR test (Little, 1988) using SPSS statistical software. The null hypothesis was not rejected, indicating that the missingness of data was completely at random (MCAR). Following the guidelines recommended by Newman (2014) for missing data, all the available data were used for data analysis. Hence listwise deletion was not used and data from partial respondents was not discarded in the data analysis. Utilizing guideline 4 recommended by Newman (2014), when conducting construct-level analysis for the scales, a participant's average response (mean of the scale) was used even if a participant responded to only one item in the multi-item scale. This mean was used to represent the participant's scale score.

Results

Demographic Characteristics/Profile of the sample

Of the 200 participants approached, 167 (83.5%) agreed to participate in the study and accessed the survey. Of those, 134 (75.7%) were eligible and comprised the sample size in the study. Results on participants' demographics included data from the total sample (N=134). Summary of the participants' demographics are presented in Table 2. The sample was composed of 78 females (65.5%). In terms of age, 69.8% (83/134) of all respondents were between the ages of 35-54 years, 18.5% (22/134) were between the ages of 18-34 years, and 11.7% (14/134) were above 55 years of age. The country of birth of the majority of the respondents (105/134, 87.5%) was India, followed by United States (7/134, 5.8%), Nepal (3/134, 2.5%), and Pakistan (2/134, 1.7%). There were no respondents whose country of origin was Bangladesh, Sri Lanka, or Bhutan. About

59.1% (52/134) of the respondents had a gross family income between $80,000 and $200,000, and 26.1% (23/134) had a gross family income of over $200,000. Forty-six respondents did not report family income. A majority of the sample (99/134, 84.6%) reported having a Bachelor's degree and above, and 71% (83/134) were employed full-time. Only 8.5% (10/134) were students and 1.7% (2/134) were retired.

In terms of health status, less than 2% of all the respondents (2/134) perceived themselves to be in poor condition, whereas 49.2% (59/134) perceived themselves to be in good health, and 49.2% (59/134) perceived themselves to be in very good or excellent health. Eighty one percent (94/134) of the respondents did not report any chronic diseases. The most common self-reported chronic diseases were hypertension, diabetes, obesity and heart disease.

Only 20.7% (23/134) respondents reported Hindi as their first language, which is the national language of India. Majority of the respondents (62/134, 55.9%) reported other languages as their first language, including Malayalam, Tamil, Telugu, Kannada, Gujarati, Punjabi, and Marathi, which are regional languages spoken in different states in India.

Smartphone and Digital Tablet Ownership

Ninety seven percent of the respondents (130/134) reported owning a smartphone (e.g. Apple iPhone, Samsung Galaxy, Google Nexus, Microsoft Lumia or Sony Xperia) that can be used to download mobile applications. Seventy three percent (99/134) of the respondents also owned a digital tablet (e.g. Apple iPad, Samsung Galaxy tablet, Google Nexus tablet, Sony Xperia tablet) that can be used to download mobile applications. Ninety five percent (121/134) of the respondents reported accessing the Internet using their

smartphones and/or digital tablet a few times (16.4%, 22/134) to many times (73.9%, 99/134) each day.

Smart and Connected Device Usage

The respondents were categorized into three groups: non-users, past users, and current users of smart and connected devices. Respondents that regularly track one or more aspect of their health or well-being using consumer wearables (such as fitness trackers), and smart medical devices, (such as blood sugar monitors) were defined as current users of smart and connected devices. Respondents that had stopped using the smart devices were defined as past-users. Respondents that reported that they do not regularly monitor any aspect of their personal health using these mHealth tools were defined as non-users.

Table 3 illustrates the profile of connected (wearable and smart) device users, non-users and past users. Of the 134 respondents that began the survey, only 109 (81.0%) answered the questions pertaining to connected device use. Of the 109 respondents, 47 (43.0%) reported to be current users of connected devices. Females comprised 58.1% (25/47) of the current device users. A majority (79.1%, 34/47) of the users of connected devices were between the ages of 35-54 years, whose country of birth was India (91.0%, 40/47). Twenty-five (58.1%) of the device users were highly educated (Master's degree and above), and 27 (84.4%) of the users who responded to the income question had annual incomes above $80,000. Thirty-five (81.4%) of the users worked full-time. All (100%) of the device users perceived their health status to be good, very good or excellent, 76.2% (32/47) of them reporting no chronic diseases.

Among the 21 past users of connected devices who reported discontinued use of the devices, 14 (66.7%) were female, 15 (71.4%) were between the ages of 35-54 years of

age, and the majority (95.2%) were from India. All the past users had incomes above $80,000, 76.1% (16/21) had a Master's degree or above, and 81.0% (17/21) had full-time work. The majority (95.2%, 20/21) of the past users perceived their health status to be good, very good or excellent with no chronic diseases (90.5%, 19/21). Only one past user (4.8%) perceived their health to be rather poor.

Among the 41 non-users of smart and connected devices, the majority (75.6%, 31/41) were female. A majority of the non-users were (65.8%27/41) were between the ages of 35-54 years. A majority of the non-users (33/41, 80.5%) were of Indian origin. The gross annual family income of 26 (84%) of the non-users was above $80,000. Fifteen (37.5%) of the non-users had a Bachelor's degree and 15 (37.5%) had a Master's degree. Twenty-seven (65.9%) of the non-users had full-time work and all of them perceived their health status to be good, very good or excellent. The majority (84.6%, 33/41) of non-users of devices self-report having no chronic diseases.

A chi-square test of independence using Fisher's Exact test was used to examine group differences in gender, country of birth, employment, income and chronic diseases among users, non-users, and past users of smart and connected devices (Table 4). In order to compare group differences, income was categorized into three income categories: below $100,000, between $100,000 and ≤ 200,000, and above $200,000. The employment categories were also grouped into employed (full-time and part-time), students, not employed, and other. There was a statistically significant association between smart device use and employment, χ^2 (4, N = 105) = 12.262, p = 0.019. Device non-users were more likely to be students than other groups. There was no statistically significant difference in

gender, country of birth and chronic diseases among the current users, past users and non-users of smart and connected devices.

Kruskal-Wallis test using Exact test was used to compare age, gross family income, education level and perceived health status among current users, non-users and past users of smart and connected devices. Age was categorized into three categories: 18-34 years, 35-54 years and 55+ years. There was a statistically significant difference in device use between the different age groups, $\chi^2(2) = 9.638$, $p = .007$. Non-users were more likely to be between 18 – 34 years of age than past users. There was no statistically significant difference in family income, education level, and perceived health status among current users, non-users and past users of smart and connected devices.

Mobile Health Application (App) Usage

The respondents were categorized into 3 groups: non-users, past users, and current users of mobile health apps. Respondents that regularly track one or more aspect of their health or well-being using mHealth apps were defined as current users of apps. Respondents that had stopped using the apps were defined as past-users. Respondents that reported that they do not regularly monitor any aspect of their personal health using these mHealth tools were defined as non-users.

Table 5 illustrates the profile of mobile health app current users, non-users and past users. Of the 134 respondents that began the survey, only 125 (93.2%) answered the questions pertaining to mobile health app use. Of the 125 respondents, 78 (62.4%) reported to be current users of mobile health apps. Females comprised 61.4% (43/78) of the app users. A majority (71.5%, 50/78) of the app users were between the ages of 35-54 years, whose country of birth was India (87.4%, 62/78). Forty-three (61.4%) of the app users were

highly educated (Master's degree and above), and 48 (87.3%) of the app users who responded to the income question had annual incomes above $80,000. Fifty-two (75.4%) of the users worked full-time. A majority (98.6%) of the app users perceived their health status to be good, very good or excellent, 78.3% (54/78) of them reporting no chronic diseases.

Among the 11 past users of mobile health apps who reported discontinued use of the apps 9 (90.0%) were female, one was male and one did not respond. Nine (9.00%) of the past users were between the ages of 35-54 years of age, a majority of them (90.0%) were from India. Six (85.7%) of the past users had incomes above $80,000, 90.0% (6/11) had a Master's degree or above, and 80.0% (8/11) had full-time work. All of the past users perceived their health status to be good, very good or excellent but 8 (80.0%) of the past users reported having a chronic illness.

Among the 36 non-users of mobile health apps, the majority (68.6%, 24/36) were female. Although a majority (68.6%,24/36) of the non-users were between the ages of 35-54 years, 22.8% (8/36) of non-users were between the ages of 18-34 years and 8.6% (3/36) above 55 years of age. The country of birth of the majority (31/36, 88.6%) of the non-users was India. The gross annual family income of 21 (91.3%) of the non-users was above $80,000. Thirteen (38.2%) of the non-users had a Bachelor's degree, 13 (38.2%) had a Master's degree, and 4 (11.8%) had a doctorate. Twenty-three (65.7%) of the non-users had full-time work and all of them perceived their health status to be good, very good or excellent. The majority (93.9, 31/36) of the non-users reported not having chronic diseases.

A chi-square test of independence was done to examine group differences in gender, country of birth, occupation, and chronic diseases among current users, non-users,

and past users of mobile health apps (Table 6) There was no statistically significant difference in gender, country of birth, occupation, and chronic diseases among current users, non-users and past users of mobile health apps.

Kruskal-Wallis test was used to compare age, gross family income, education level and perceived health status among current users, non-users and past users of mobile health apps. Age was collapsed into three categories: 18-34 years, 35-54 years and 55+ years. There was no statistically significant difference in age, family income, education level and perceived health status between the users, non-users, and past users of mobile health apps.

Health Aspects Monitored with Mobile Health Applications

Current users of mobile health applications monitored a varied of health aspects using these applications. A majority (65/78, 83.3%) of them used these apps to monitor their physical activity, 37 (47.4%) used them for weight-related information, and 34 (43.6%) for nutrition and eating habits. Mobile health apps were also used for monitoring sleep patterns (27/78, 34.6%), to track performance in sports (20/78, 25.6%). As far as monitoring the chronic diseases, 16 (20.5%) used the apps for cardiovascular and respiratory health, and only five (6.4%) for diabetes, seven (9%) for sexual and reproductive health, and four (5.1%) for medication use.

Motivations for Using Mobile Health Applications

The respondents in the current study were more motivated to use mobile health apps for monitoring and keeping track of their well-being, rather than for monitoring chronic diseases or illnesses (Table 7). This was determined by the responses of “rather strongly” or “strongly” to the questions pertaining to the motivations of mobile health app use. Of the 78 respondents who indicated they were users of mobile health apps,

there were partial responses to the questions regarding motivations for use. Percentages were reported only for the respondents, and the number of non-respondents is presented in the table. Fifty respondents (74.7%) reported using mobile health apps to know themselves better and monitor changes in parameters that they consider important for their health. Forty-nine (71%) of the users of mobile health apps reported that the apps gave them daily encouragement towards reaching their personal health and wellness goals and 25 (40%) of the respondents reported that the apps helped them in monitoring progress made in their athletic training.

Only 22 (34.4%) current users of mobile health apps reported using the apps to improve communication with their health care providers or to reduce the number of times they need to see the doctor (16/78, 26.7%). Only 13 respondents (21.3%) reported that the apps help them take their medications on time.

Data Sharing Behaviors

Of the 78 current users of mobile health apps, only 75 answered the questions regarding data sharing. Only a small percentage (21/75, 28%) of the current users reported sharing their data on health and well-being recorded in the apps with other people. A majority of the users that shared the data (17/21, 80.9%) shared it with family members, and 52% (11/21) shared it with friends. Only six people (28%) shared the data with their family doctor, two (9.5%) shared the data with a nurse, and only one (4.7%) reported sharing their data with their therapist. Four (19%) of the users reported sharing their data with individuals or groups on social media, and 2 (9.5%) people reported sharing their data with their personal trainer and other users of the same mobile app respectively.

Adoption and Use of Smart and Connected Devices

Of the 123 respondents who answered the questions regarding their knowledge of smart and connected devices, 88.6% (108/123) had already heard of smart devices for health and well-being. However, the level of familiarity remained low with these devices because only 38.5% (47/123) reported being "very or extremely familiar" with these devices.

Of the 47 current users of smart and connected devices, 59.6% (28/47), reported owning one device, 27.7% (13/47) owned two devices, 10.6 % (5/47) owned three devices, and only one respondent (2.1%) reported owning more than 10 devices. A majority of the respondents (12/47, 25.5%) reported using these devices between 1 to 2 years, 10 respondents (21.3%) between 2 and 5 years, 9 (19.1%) between 6-12 months, and 14 (29.8%) between 3-6 months. Only 2 respondents (4.3%) reported using these devices less than 3 months.

In terms of usage of types of smart and connected devices, the most popular devices were bracelet, wristband or smartwatch with 43 (91.5%) of those who owned at least one such device. Bathroom scale was the next popular device with 22 users (46.8%) who owned them, followed by blood pressure monitor (14/47, 29.8%), pedometer (11/47, 23.4%) and thermometer (11/47, 23.4%).

Respondents were asked how often they used the smart and connected devices. Answers to this question varied across devices and according to the users' specific needs. For example, 52.4% of users of the bracelet, wristband, or watch used them many times each day. Among the users of the bathroom scale 40% used it once a day. Among the users of blood pressure monitor, 36.4% used it once a day, whereas the others used them from 3-5 times per week to once a month or less. None of the respondents reported use of

intelligent clothing, intelligent pill dispenser, and only one respondent reported using other devices using a band, and connected optical devices or hearing aids.

Users' Acceptance of Mobile health apps

In the current study, 78 respondents self-reported to be users of mobile health apps, but the full-response rate for the scales for PEOU, PU, user satisfaction, confirmation of initial expectations and intention to continue using apps varied from 82% to 91%. As shown in Tables 8 and 9, users of mobile health apps reported to be satisfied (mean=3.5 on a 5-point Likert scale), perceived their apps to be useful (mean=3.8), perceived them to be easy to use (mean=4.0), perceived that the initial expectations towards these apps were confirmed (mean=4.0) and had reported intention to continue using the apps (mean=4.2).

Perceived Usefulness: About 65.6% (40/61) of the users of the apps agreed or strongly agreed to the statements that they have maintained or improved their health condition with the use of the apps. About 68.3% (43/63) users reported that they are more informed about their health, 65.6% (42/64) reported that their knowledge of their health condition had improved. About 62.5% (40/64) reported that they feel more confident in taking care of their health, 66.2% (41/62) reported that they are more autonomous in the management of their health with the use of the mobile health apps, and 42.9% (27/63) reported that they feel less anxious about their health. About 62% (39/63) of the users reported having more informed discussions with their doctor with the use of their mobile health apps.

Perceived Ease of Use: A majority (89%, 57/64) of the users of mobile health apps found their apps to be easy to use, 76.5% (52/68) users found the apps to be user-friendly, 78.4% (51/65) users reported that learning how to use the apps was easy, and 79.7% (51/64)

users reported that the information provided in the mobile apps was easy to understand and interpret.

User Satisfaction: A majority of the users (43/71, 60.6%) were satisfied with the use of the apps. Thirty-nine (56.5%) were pleased with their use of the apps, and 48.5% (32/66) were delighted with the use of the apps.

Confirmation of Initial Expectations: A majority (47/64, 73.4%) of the app users agreed or strongly agreed that their initial expectations of how they would use their apps were confirmed so far. Forty-three (68.3%) of the users reported that using their apps turned out to be easier than they first thought. About 77.4% (48/62) agreed or strongly agreed that there were more benefits to using their apps than they first thought.

Intention to Continue Use

Fifty-three users (85.5%) reported of having every intention of continuing to use health apps in the future. Fifty-one (79.7%) users reported that they will continue using health apps to monitor different aspects of their health, and 47 (74.6%) users reported that they have no intention of stopping their use of health apps in the future.

Bivariate analyses

To determine the relationships between perceived usefulness, perceived ease of use, user satisfaction, confirmation of initial expectations and intention to use for mobile health app use, a Pearson product-moment correlation coefficient analysis was performed. The results are presented in Table 10. The analysis indicated a moderate positive correlation between PEOU and PU, which was statistically significant (r= .53, n = 64, p < .001). There was a strong positive correlation between PEOU and user satisfaction (r= .72, n = 68, p < .001), and between PEOU and intention to continue using (r= .65, n = 64, p < .001). There

was a moderate positive correlation between user satisfaction and PU (r= .59, n = 64, p < .001) and a strong positive correlation between user satisfaction and intention to continue using apps (r= .60, n = 64, p < .001). There was also strong positive correlation between PU and intention to continue using (r= .70, n = 64, p < .001). There was a strong positive correlation between confirmation of initial expectations (COE) and PEOU (r= .64, n = 63, p < .001), a strong correlation between COE and PU (r= .71, n = 63, p < .001), a moderate correlation between COE and user satisfaction (r= .53, n = 64, p < .001), and a strong correlation between COE and intention to continue using (r= .74, n = 63, p < .001)

Reliability analyses

The internal consistency reliability estimates of the five scales of PEOU, PU, user satisfaction, confirmation of initial expectations and intention to continue using mobile apps were analyzed in the study using Cronbach's alpha. An internal consistency estimate of ≥ .70 was set as the a priori criterion for acceptable evidence of scale reliability (DeVellis, 2003). The reliability estimates for the five scales are shown in Table 9. The total scale Cronbach's alphas were all above the .70 threshold.

Users' Acceptance of Smart and Connected devices

In the current study, 47 respondents self-reported to be users of smart and connected devices, but the full-response rate for the scales for PEOU, PU, user satisfaction, confirmation of initial expectations and intention to continue using smart and connected devices varied from 68% to 72%. As shown in Tables 11 and 12, users of smart and connected devices reported to be very satisfied (mean=4.1 on a 5-point Likert scale), perceived their devices to be useful (mean=4.1), perceived them to be easy to use

(mean=4.2), perceived that the initial expectations towards these devices were confirmed (mean=4.2) and had reported intention to continue using the devices (mean=4.4).

Perceived Usefulness: About 77.1% (27/35) of the users of the smart devices agreed or strongly agreed to the statements that they have maintained or improved their health condition with the use of the devices. About 86.1% (31/36) users reported that they are more informed about their health, 74.3% (26/35) reported that their knowledge of their health condition had improved. About 68.6% (24/35) reported that they feel more confident in taking care of their health, 69.4% (25/36) reported that they are more autonomous in the management of their health with the use of the smart devices, and 68.5% (24/35) reported that they feel less anxious about their health. About 71.4% (25/35) of the users reported having more informed discussions with their doctor with the use of their smart and connected devices.

Perceived Ease of Use: A majority (80.5%, 29/36) of the users of smart devices found them to be easy to use, 78.9% (30/38) users found the devices to be user-friendly, 84.2% (32/38) users reported that learning how to use the devices was easy, and 78.4% (29/37) users reported that the information provided in the smart devices was easy to understand and interpret.

User Satisfaction: A majority of the users (31/39, 79.5%) were satisfied with the use of the smart devices, 84.2% (32/38) were pleased with their use of the devices, and 73.1% (30/37) were delighted with the use of the devices.

Confirmation of initial expectations: A majority (28/37, 75.7%) of the device users agreed or strongly agreed that their initial expectations of how they would use their devices were confirmed so far. Twenty-five (69.4%) of the users reported that using their

devices turned out to be easier than they first thought. About 83.3% (30/36) users agreed or strongly agreed that there were more benefits to using their devices than they first thought.

Intention to continue use: Thirty users (85.6%) reported of having every intention of continuing to use wearable or smart devices in the future, 85.6% (30/35) users reported that they will continue using their wearable or smart devices to monitor different aspects of their health, and 82.8% (29/35) users reported that they have no intention of stopping their use of wearable or smart devices in the future.

Bivariate analyses

To determine the relationships between perceived usefulness, perceived ease of use, user satisfaction, confirmation of initial expectations and intention to continue using for smart and connected device use, a Pearson product-moment correlation coefficient analysis was performed. The data were assessed for violation of statistical assumptions prior to analysis. The results are presented in Table 13. The analysis indicated a strong positive correlation between PEOU and PU, which was statistically significant (r= .72, n = 34, p < .001). There was a strong positive correlation between PEOU and user satisfaction (r= .78, n = 33, p < .001), and a very strong correlation between PEOU and intention to continue using (r= .91, n = 31, p < .001). There was a very strong positive correlation between user satisfaction and PU (r= .87, n = 31, p < .001) and a very strong positive correlation between user satisfaction and intention to continue using apps (r= .87, n = 31, p < .001). There was also a very strong positive correlation between PU and intention to continue using (r= .80, n = 32, p < .001). There was a strong positive correlation between confirmation of initial expectations (COE) and PEOU (r= .84, n = 31, p < .001), a strong correlation between

COE and PU (r= .82, n = 32, p < .001), a strong correlation between COE and user satisfaction (r= .77, n = 31, p < .001), and a strong correlation between COE and intention to continue using (r= .84, n = 32, p < .001)

Reliability analyses

The internal consistency reliability estimates of the five scales of PEOU, PU, user satisfaction, confirmation of initial expectations and intention to continue using smart devices were analyzed in the study using Cronbach's alpha. An internal consistency estimate of ≥ .70 was set as the a priori criterion for acceptable evidence of scale reliability (DeVellis, 2003). The reliability estimates for the five scales are shown in Table 12. The total scale Cronbach's alphas were all above the .70 threshold.

Reasons for Discontinuation of the use of MHealth Technology

Mobile health apps. Among the respondents who discontinued use (past users) of their mobile health apps, 45.5% (5/11) reported stopping use for no specific reason, 27.3% (3/11) reported that they had lost interest in this type of app, 18.2% (2/11) found that the apps were too complicated to use, and 18.2% (2/11) reported that entering data in an app was too time-consuming. None of the respondents in this study had discontinued the app use due to concerns of security or about unauthorized third parties making inappropriate use of their personal data (Table 14).

Smart and connected devices. Among the respondents who discontinued use of their smart devices (Table 15), 42.9% (9/21) didn't like carrying or wearing the type of device with/on them, 38.1% (8/21) lost interest in the kind of device, 28.6% (6/21) reported discontinuing use for no particular reason, whereas 23.8% (5/21) reported that they had acquired this type of device more out of curiosity than to make use of it. Only one

respondent (4.8%) reported discontinuing the device use due to doubts about the reliability of the information generated by the device they were using.

Reasons for not Owning Smart and Connected Devices

Among the non-users of smart devices for health, 43.8% (14/32) reported that they were not interested and 25% (8/32) reported that the smart devices for health were too expensive. About 18.8% (6/32) reported either being worried that they would not know how to make good use of them, or had doubts about the reliability of the measures they take, or were worried about unauthorized third parties making inappropriate use of their personal data respectively (Table 16). About 15.6% (5/32) of the non-users felt that the devices would intrude on their privacy.

Only 28.1% (9/32) non-users reported that were either very likely or somewhat likely thinking about buying a health or well-being connected device in the next 12 months. Most (75%) reported interest in buying either a bracelet or watch, followed by bathroom scale (16.7%), toothbrush (16.7%), and pedometer (16.7%).

Discussion

The cross-sectional study described the types and extent of mHealth technology (mobile health applications and smart and connected device) ownership and usage, the factors related to the usage and non-usage of such technology, and examined the group differences among users, non-users and past users of mHealth technology. The study also examined the correlations between the scores of the scales measuring user appreciation of connected care technologies (apps and wearables) namely, perceived ease of use, perceived usefulness, user satisfaction, confirmation of initial expectations and intention

to continue using among users of mHealth technology in South Asian adults living in the United States.

Overall, 97.0% of the respondents in the current study reported owning a smartphone that can be used to download mobile applications, and 90.0% of them reported accessing the Internet using their smartphones few to many times each day. These findings are in line with those of Pew Research Center that 91% of English-speaking Asian Americans owned a smartphone (Perrin, 2016) which is higher than Americans in general at 81% (Pew Research Center, 2019). Possible explanations for higher rates of smartphone usage among SAs might be that the majority of the sample of the current study reported a high annual income of over $80,000, and reported higher education with 84.6% of respondents had a Bachelor's degree or above. These findings seem to be consistent with the findings of Pew Research Center that smartphone owners are more likely to be more affluent and highly educated (Anderson, 2015).

The majority of the participants in the current study were of Indian origin. As of 2015, Asian Indians accounted for 20% (4 million) of the national Asian population and represented the largest South Asian population in the US (Lopez, Ruiz, & Patten, 2017). Although the population of other South Asian subgroups are growing in the United States since 2010, the overall percentage is lesser than those of Indian descent (Pew Research Center, 2017). According to Pew Research Center, 80% of Asian Indians are English proficient, over 70% have a Bachelor's degree or higher, and only 7.5% live in poverty (2015). The median annual income of Asian Indians is $100,000, as compared to $73,060 among all Asians in the U.S. The income and education of the participants of the current study are consistent with the findings of Pew Research Center (2015).

In the current study, 62.4% of the participants reported to be current users of mobile health apps. This finding is consistent with the findings of a survey conducted in the US in which 58.23% of mobile phone users reported having downloaded a health-related mobile app (Krebs & Duncan, 2015).This finding was significant because although the national survey conducted by Krebs and Duncan (2015) had a good representation of the Asian population (7.11%), it did not differentiate between the different Asian subgroups. Disaggregated data obtained on the South Asian population is essential in order to design and tailor intervention programs.

Some of the demographics of app users were similar to other surveys done in the US. Participants with higher incomes and education were more likely to use health apps (Krebs & Duncan, 2015). However, in the current study the majority of app users were in the age group of 35-54 years (71.5%). This finding was different from other studies that reported higher app use among younger age groups between the ages of 18-29 years (Krebs & Duncan, 2015). Possible explanation for this may include that the majority of the sample (69.8%) in the current study were between the ages of 35-54 years of age, and only 18.5% were between the ages of 18-34 years of age. There was also no statistically significant association between age and app use. The rate of app use was lowest (11.4%) in the participants above the age of 55 years in the current study. Perceived usefulness, perceived value of and confidence in learning the technology are important predictors in technology adoption in older adults (Berkowsky, Sharit & Czaja, 2018). Studies have also shown that older adults face several barriers to technology adoption ranging from physical challenges to a lack of comfort and familiarity with technology (Anderson & Perrin, 2017).

In terms of the common reasons for app use, the findings of the current study are consistent with findings of previous surveys indicating that exercise/physical activity, nutrition, weight management, and cardiovascular health apps are most popular among the users of apps (Krebs & Duncan, 2015, Pare et al., 2018). In terms of motivations for using mobile health apps, the primary motivations of the users included monitoring and tracking their well-being, and for reaching personal health and wellness goals. Only a minority of the participants reported using them to improve communication with their health care providers. This was further evidenced by the low number of participants reporting sharing their health data with their health care providers. These findings were also consistent with studies done in Canada (Pare et al., 2018) and in the US (Krebs & Duncan, 2015).

Although consumers' expectations were not explored in the current study, improved communication with the health care system and better integration of the apps with the medical records were preferred potential app features by consumers (Krebs & Duncan, 2015). The US Food and Drug Administration (FDA) has issued final guidelines for the developers of mobile medical apps (Fornell, 2013). This might encourage more health care providers to recommend approved apps and devices, and encourage users to share their data with them.

In the current study, 43.1% of the participants reported to be current users of smart and connected devices, which includes wearable devices. These findings are similar to the findings of a recent study conducted by PricewaterHouseCoopers (PwC) in 2017 which reported that almost 49% of the US population own a wearable device (Russey, 2018). However, these findings were lower than a survey conducted by

Valencell in 2018 on a sample of 826 U.S. consumers which reported 64% of either current or past user of a wearable technology device. A majority (91.5%) of the users of connected devices in the current study reported using bracelet, wristband, or smartwatch. These findings were slightly higher than the study by PwC which reported 45% of the consumers using a fitness band, and 27% a smartwatch (Russey, 2018), but similar to the findings of the survey conducted by Valencell which reported 53.82% ownership of Smartwatch and 44.78% of wristband (Valencell, 2018). Similar to the app users, a majority (79.1%) of connected and wearable devices in the current study were females between the ages of 35-54 years of age. Both the surveys conducted by PwC and Valencell were conducted on the general US population and not specifically on the South Asian population. These findings indicate that the usage of smart and connected devices South Asians are similar to the national population in the U.S.

An important finding in the current study was that non-users of smart and connected devices were more likely to be between 18-34 years of age and more likely to be students than other groups. . Several studies (Carroll et al., 2017) and internet surveys (Panner, 2019) have reported the highest use of mobile health apps and wearable devices among the millennials. These are contrary to the findings in the current study. This could be explained by the lower number (18.5%) of participants in the age group of 18-34 years and only 8.5% of participants were students. A more focused study for this age group and for students in the South Asian population may be warranted to validate and further understand these results.

Reasons for discontinuation of smart and connected devices were similar to other studies that included hassles of carrying and/or recharging them, losing interest, and

malfunctioning of the devices (Pare et al., 2018; Valencell, 2018). Participants in the current study had confidence about the accuracy of the data of their wearables and did not indicate that as a reason for discontinuation, which was similar to other surveys conducted in the US, where 76% of the wearable users trusted the heart rate data from their devices (Valencell, 2018). This shows that discontinuation due to concerns about privacy and accuracy will not be a problem among SAs in the U.S. Devices designed to address the concerns of malfunction, and recharging are likely to be more accepted and used among SAs.

Among the non-users in the current study, lack of interest in the devices and cost were the most common reasons for not owning a smart device. This finding was similar to a national survey in the US, where non-users reported cost and lack of clear benefit in addition to lack of interest for not owning the device (Valencell, 2018). Privacy concerns were also reported by non-users of the current study. These findings regarding privacy concerns were consistent with those from a survey done by Consumers International and Internet Society across 6 developed countries which found that 28% of people do not own or do not intend to purchase a connected device due to lack of trust in security and privacy (Internet Society, 2019). Developers of smart and connected devices need to take these privacy concerns into consideration and have security features that protect the privacy of the users.

In the current study, there was no statistically significant association between the presence of chronic disease, or health status and app use or smart device use. This finding was not consistent with some of the studies that have reported that individuals with poor self-reported health were least likely to download and use these health tools (Dias et al.,

2017). A possible explanation could be that in the current study, less than 2% of all the respondents perceived themselves to be in poor condition, whereas the others perceived themselves to be in either good, very good or excellent health. Although the sample consisted of a majority of participants of Indian origin, it is noticeable that there were no statistically significant associations between country of birth and app or device use.

User acceptance of connected care technologies (smartphone health apps and smart and connected devices) as measured by the mean scores of scales for perceived usefulness, perceived ease of use, user satisfaction, confirmation of initial expectations, and intention to continue using were high in the current study Users of smart and connected devices reported to be very satisfied (mean=4.1 on a 5-point Likert scale), perceived their devices to be useful (mean=4.1), perceived them to be easy to use (mean=4.2), perceived that the initial expectations towards these devices were confirmed (mean=4.2) and had reported intention to continue using the devices (mean=4.4). Users of mobile health apps reported to be satisfied (mean=3.5 on a 5-point Likert scale), perceived their apps to be useful (mean=3.8), perceived them to be easy to use (mean=4.0), perceived that the initial expectations towards these apps were confirmed (mean=4.0), and had reported intention to continue using the apps (mean=4.2).

The findings of user acceptance of connected care technology in the current study were consistent with studies done on a non-South Asian population in Canada (Pare et al., 2018). Other studies have explored user perceptions towards mHealth technology, especially perceived ease of use, and perceived usefulness and their significant effect on user intention (Zhang et al., 2017). A recent study on usability of mobile apps revealed that both mHealth insiders and consumers regarded user satisfaction, learnability, and

efficiency of the mHealth apps as important for continued use (Liew, Zhang, See, & Ong, 2019). The participants in the current study were satisfied with their apps and connected devices, and perceived them to be easy to use, and useful, and also reported strong intention to continue using these technologies. An intervention designed to utilize mHealth technologies in order to bring about behavior change has the potential to be successful in this population.

The research model was not tested for the current study. However, the model was tested by Pare et al. (2018) in a Canadian sample using PLS regression analyses, and supported all relationships between the variables (Figure 1). The tested model in the study by Pare et al. (2018) indicated that confirmation of initial expectations was strongly related to PEOU, PU and user satisfaction and explained 64% of the variance in the dependent variable (intention to continue using mHealth). The intent to use or behavioral intent to use technology has been shown to be a reliable indicator of actual usage (Turner, Kitchenham, Brereton, Charters, & Budgen, 2010).

Strengths and Limitations

This study has various strengths and limitations. The main strength of this study is the fact that it is the first study conducted in the United States to explore the usage and acceptance of mHealth technology, both mobile health apps and wearable devices among South Asian adults. The results from this study provide important baseline information that will guide future research and interventions in the South Asian population living in the United States using mHealth technology. Although, a convenience sample was utilized for the study, the participants represented different ages, income and education levels. The study explored various aspects of mHealth use, including reasons for

continued use, discontinuation of use, and for non-usage of these technologies. The study also investigated various factors of user appreciation of these technologies among South Asian population.

Despite the strengths of the study, several limitations were noted. The utilization of cross-sectional design limits the ability to interpret causal-effect relationships. The cross-sectional design also does not help in understanding the usage of these technologies over time. The responses were based on self-report and utilized a convenience sample. The sample did not represent all of the different South Asian population, since the majority of the respondents' country of origin was India. Hence the results may not be generalizable across the different South Asian groups. There was possible respondent burden due to the length of the survey and multiple questionnaires covering similar concepts (Rolstad, Adler, & Ryden, 2011) leading to non-response rate and missing data. This was offset by oversampling and also by calculating the mean score of the scale even if the respondent only answered one item of the scale (Newman, 2014). Although the study used valid and reliable instruments, self-report instruments are inherently susceptible to information and recall bias with a chance of overestimation of the studied variables.

Conclusion and Recommendations

Based on the study findings, 62.4% of the participants are current users of mobile health apps to monitor their health. About 43% of the participants are current users of smart and connected devices. There were no significant differences in country of birth, gender, income, employment, perceived health status, and education among users, non-users and past/discontinued users of mobile health apps or smart and connected devices.

Users of mobile health apps and smart devices were mainly between the ages of 35-54 years of age, highly educated, with a higher income, whose main motivation for use of mHealth technology was to monitor their wellness and fitness goals.

Although there were some limitations, the study provides valuable data about mHealth (mobile health apps, and smart and connected device) use among South Asian adults living in the US. The results highlight the high usage and acceptance of mHealth apps in a large segment of the South Asian adults living in the US. The usage and acceptance of smart and connected devices were at par with the general American population. Given these findings, health care providers can use the information generated by these devices/apps to monitor indices for chronic disease management, and provide preventative care and increase patient empowerment. Since the findings suggest that SAs living in the U.S. use mHealth technology largely to monitor their physical activity and nutrition, researchers can utilize these technologies to design interventions in order to increase physical activity and improve diet in the South Asian population that is at a higher risk for cardiovascular disease.

Although the users reported a high intent to continue using mHealth technology, long-term studies are needed to provide evidence of long-term use, and of sustained behavioral changes. Further qualitative and quantitative research is also needed targeting the other South Asian subgroups that were not represented in the current study to explore their usage and acceptance of mHealth technology. Further research is also needed to investigate the usage of mHealth technology among South Asian millennials and students living in the US.

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Table 1

Variable description and sources

Variables	**Study Aim Addressed**	**Descriptions/Measures**
Demographics	Sample description and Aim 2	Demographic data (age, gender, education level, occupation, family income, health insurance, country of birth, marital status, chronic disease).
Acceptance and intention to continue using	Aim 3	Perceived ease of use (PEOU) -4 items (Pare et al., 2018)- Adapted from Davis (1989). Cronbach's alpha - .92 Perceived usefulness (PU)- 7 items (Pare et al., 2018) -Adapted from Davis (1989) Cronbach's alpha - .90 User satisfaction- 3 items (Pare el al., 2018) – Adapted from Bhattacharjee (2001), and Hong et al. (2006). Cronbach's alpha - .89 Confirmation of Initial Expectations -3 items (Pare et al., 2018) – Adapted from Bhattarcharjee (2001), Hong et al. (2006). Cronbach's alpha - .80 Intention to continue using- 3 items (Pare et al., 2018) Adapted from Bhattacharjee (2001), and Hong et al. (2006). Cronbach's alpha - .91
Motivations to use	Aim 2	Motivations to use -10 items (Pare et al., 2018). – Adapted from prior surveys on consumer digital health
Perceived health status	Aim 2	Single item measure of perceived health status (Pare el al., 2018).
Types of ownership of mHealth technology	Aim 1	Type of usage (Pare et al., 2018) Apps- type and number of apps used, duration of app use, reasons for use, data sharing Smart and connected health devices - familiarity, duration and frequency of use, number of devices used/owned, type of devices used
Reasons for discontinuation and non-usage	Aim 4	Reasons for non-usage 11 items (Pare et al., 2018) Reasons for discontinuation 11 items (Pare et al., 2018) Adapted from other surveys

Table 2

Demographic profile of the study sample (N=134)

Characteristics	***Frequency (Percentage)***
Gender	
Male	41 (34.5)
Female	78 (65.5)
Non respondents or prefer not to answer	15
Age	
18-24 years	14 (11.8)
25-34 years	8 (6.7)
35-44 years	40 (33.6)
45-54 years	43 (36.2)
55 – 64 years	11 (9.2)
65-74 years	1 (0.8)
>75 years	2 (1.7)
Non respondents or prefer not to answer	15
Country of Birth	
India	105 (87.5)
Bangladesh	0 (0.0)
Pakistan	2 (1.7)
Sri Lanka	0 (0.0)
Nepal	3 (2.5)
Bhutan	0 (0.0)
United States	7 (5.8)
Other	3 (2.5)
Non respondents or prefer not to answer	14
Gross Family Income	
<$20 K	7 (8.0)
≥$20K and ≤$40K	3 (3.4)
≥$40K and ≤60K	1 (1.1)
≥$60K and ≤80K	2 (2.3)
≥$80K and ≤100K	21 (23.9)
≥$100K and ≤200K	31 (35.2)
>200K	23 (26.1)
Non respondents or prefer not to answer	46
Education level	
Secondary School	7 (6.0)
College	7 (6.0)
Certificate	4 (3.4)
Bachelor's degree	34 (29.1)
Master's degree	50 (42.7)
Doctorate	15 (12.8)
Non respondents or prefer not to answer	17
Occupation	
Full-time work	83 (71.0)
Part-time work	10 (8.5)
Student	10 (8.5)
Looking for work	3 (2.6)

At-home full time	7 (6.0)
Retired	2 (1.7)
Other	2 (1.7)
Non respondents or prefer not to answer	17
Perceived health status	
Rather poor	2 (1.6)
Good	59 (49.2)
Very good	35 (29.2)
Excellent	24 (20.0)
Non respondents or prefer not to answer	14
Chronic diseases	
Yes	22 (19.0)
No	94 (81.0)
Non respondents or prefer not to answer	18
Language	
Hindi	23 (20.7)
English	13 (11.7)
Urdu	3 (2.7)
Bengali	7 (6.3)
Nepali	3 (2.7)
Dzongkha	0 (0.0)
Other	62 (55.9)
Non respondents or prefer not to answer	23

Table 3

Profile of connected device users, non-users, and past users (N=109)

Characteristics	**Device users (N=47)**		**Device past users (N=21)**		**Device non-users (N=41)**	
	N	%	N	%	N	%
Gender						
Male	18	41.9	7	33.3	10	24.4
Female	25	58.1	14	66.7	31	75.6
Non-respondents/ prefer not to answer	4		0		0	
Age						
18-24 years	2	4.6	1	4.8	9	22.0
25-34 years	4	9.3	0	0.0	3	7.3
35-44 years	14	32.6	8	38.1	14	34.1
45-54 years	20	46.5	7	33.3	13	31.7
55+	3	7.0	5	23.8	2	4.9
Non-respondents/ prefer not to answer	4		0		0	
Country of Birth						
India	40	91.0	20	95.2	33	80.4
Bangladesh	0	0.0	0	0.0	0	0.0
Pakistan	0	0.0	0	0.0	2	4.9
Sri Lanka	0	0.0	0	0.0	0	0.0
Nepal	2	4.5	0	0.0	0	0.0
Bhutan	0	0.0	0	0.0	0	0.0
United States	2	4.5	0	0.0	4	9.8
Other	0	0.0	1	4.8	2	4.9
Non-respondents/ prefer not to answer	3		0		0	
Gross Family Income						
<$20 K	1	3.1	0	0.0	3	9.7
≥$20K and ≤$40K	2	6.3	0	0.0	1	3.2
≥$40K and ≤60K	1	3.1	0	0.0	0	0.0
≥$60K and ≤80K	1	3.1	0	0.0	1	3.2
≥$80K and ≤100K	7	21.9	4	26.7	6	19.4
≥$100K and ≤200K	12	37.5	7	46.6	10	32.3
>200K	8	25.0	4	26.7	10	32.3
Non-respondents/ prefer not to answer	15		6		10	

Education level						
Secondary School	1	2.3	0	0.0	2	5.0
College	2	4.7	1	4.7	2	5.0
Certificate	3	7.0	0	0.0	0	0.0
Bachelor's degree	12	27.9	4	19.1	15	37.5
Master's degree	21	48.8	12	57.1	15	37.5
Doctorate	4	9.3	4	19.1	6	15.0
Non-respondents/ prefer not to answer	4		0		1	
Occupation						
Full-time work	35	81.4	17	80.9	27	65.9
Part-time work	4	9.3	1	4.8	3	7.3
Student	1	2.3	0	0.0	8	19.5
Looking for work	0	0.0	1	4.8	1	2.4
At-home full time	3	7.0	2	9.5	2	4.9
Retired	0	0.0	0	0.0	0	0.0
Other	0	0.0	0	0.0	0	0.0
Non-respondents/ prefer not to answer	4		0		0	
Perceived health status						
Rather poor	0	0.0	1	4.8	0	0.0
Good	18	40.9	11	52.4	24	58.5
Very good	16	36.4	7	33.3	8	19.5
Excellent	10	22.7	2	9.5	9	22.0
Non-respondents/ prefer not to answer	3		0		0	
Chronic diseases						
Yes	10	23.8	2	9.5	6	15.4
No	32	76.2	19	90.5	33	84.6
Non-respondents/ prefer not to answer	5		0		2	

Table 4

Differences in profile of connected device users, non-users, and past users (N=109)

Characteristics	*Device users (N=47)*		*Device past users (N=21)*		*Device non-users (N=41)*		*p-value**
	N	*%*	*N*	*%*	*N*	*%*	
Gender							
Male	18	41.9	7	33.3	10	24.4	0.365
Female	25	58.1	14	66.7	31	75.6	
Non-respondents/ prefer not to answer	4		0		0		
Age							
18-34 years	6	13.9	1	4.8	12	29.3	0.007
35-54 years	34	79.1	15	71.4	27	65.8	
55+	3	7.0	5	23.8	2	4.9	
Non-respondents/ prefer not to answer	4		0		0		
Country of Birth							
India	40	91.0	20	95.2	33	80.4	0.211
Non-India	4	9.0	1	4.8	8	19.6	
Non-respondents/ prefer not to answer	3		0		0		
Gross Family Income							
<100K	12	37.5	4	26.7	11	35.5	0.862
≥$100K and ≤200K	12	37.5	7	46.6	10	32.3	
>200K	8	25.0	4	26.7	10	32.3	
Non-respondents/ prefer not to answer	15		6		10		
Education level							
High school/College	6	14.0	1	4.7	4	10.0	0.225
Bachelor's degree	12	27.9	4	19.1	15	37.5	
Graduate or higher	25	58.1	16	76.2	21	52.5	
Non-respondents/ prefer not to answer	4		0		1		
Occupation							
Employed	39	90.7	18	85.7	30	73.2	0.019
Student	1	2.3	0	0.0	8	19.5	
Not employed	3	7.0	3	14.3	3	7.3	
Other	0	0.0	0	0.0	0	0.0	
Non-respondents/ prefer not to answer	4		0		0		
Perceived health status							
Rather poor	0	0.0	1	4.8	0	0.0	0.209

Good	18	40.9	11	52.4	24	58.5	
Very good	16	36.4	7	33.3	8	19.5	
Excellent	10	22.7	2	9.5	9	22.0	
Non-respondents/ prefer not to answer	3		0		0		
Chronic diseases							
Yes	10	23.8	2	9.5	6	15.4	0.545
No	32	76.2	19	90.5	33	84.6	
Non-respondents/ prefer not to answer	5		0		2		

*Chi-square test is used to compare gender, country of birth, occupation and chronic diseases by group; Kruskal-Wallis test is used to compare age, gross family income, education level and perceived health status by group.

Table 5

Profile of App users, non-users, and past users (N=125)

Characteristics	***App users (N=78)***		***App past users (N=11)***		***App non-users (N=36)***	
	N	%	N	%	N	%
Gender						
Male	27	38.6	1	10.0	11	31.4
Female	43	61.4	9	90.0	24	68.6
Non-respondents/ prefer not to answer	8		1		1	
Age						
18-24 years	8	11.4	1	10.0	4	11.4
25-34 years	4	5.7	0	0.0	4	11.4
35-44 years	27	38.6	5	50.0	8	22.9
45-54 years	23	32.9	4	40.0	16	45.7
55+	8	11.4	0	0.0	3	8.6
Non-respondents/ prefer not to answer	8		1		1	
Country of Birth						
India	62	87.4	9	90.0	31	88.7
Bangladesh	0	0.0	0	0.0	0	0.0
Pakistan	1	1.4	0	0.0	1	2.8
Sri Lanka	0	0.0	0	0.0	0	0.0
Nepal	2	2.8	0	0.0	1	2.8
Bhutan	0	0.0	0	0.0	0	0.0
United States	5	7.0	1	10.0	0	0.0
Other	1	1.4	0	0.0	2	5.7
Non-respondents/ prefer not to answer	7		1		1	
Gross Family Income						
<$20 K	1	1.8	1	14.3	2	8.7
≥$20K and ≤$40K	3	5.5	0	0.0	0	0.0
≥$40K and ≤60K	1	1.8	0	0.0	0	0.0
≥$60K and ≤80K	2	3.6	0	0.0	0	0.0
≥$80K and ≤100K	13	23.7	2	28.6	6	26.1
≥$100K and ≤200K	18	32.7	4	57.1	9	39.1
>200K	17	30.9	0	0.0	6	26.1
Non-respondents/ prefer not to answer	23		4		13	

Education level	3	4.3	0	0.0	1	3.0
Secondary School	4	5.7	0	0.0	3	8.8
College	3	4.3	1	10.0	0	0.0
Certificate	17	24.3	4	40.0	13	38.2
Bachelor's degree	32	45.7	5	50.0	13	38.2
Master's degree	11	15.7	0	0.0	4	11.8
Doctorate						
Non-respondents/ prefer not to answer	8		1		2	
Occupation						
Full-time work	52	75.4	8	80.0	23	65.7
Part-time work	6	8.7	1	10.0	3	8.6
Student	6	8.7	1	10.0	3	8.6
Looking for work	1	1.4	0	0.0	2	5.7
At-home full time	4	5.8	0	0.0	3	8.6
Retired	0	0.0	0	0.0	0	0.0
Other	0	0.0	0	0.0	1	2.8
Non-respondents/ prefer not to answer	9		1		1	
Perceived health status						
Rather poor	1	1.4	0	0.0	0	0.0
Good	30	42.3	4	40.0	22	62.9
Very good	24	33.8	5	50.0	6	17.1
Excellent	16	22.5	1	10.0	7	20.0
Non-respondents/ prefer not to answer	7		1		1	
Chronic diseases						
Yes	15	21.7	2	20.0	2	6.1
No	54	78.3	8	80.0	31	93.9
Non-respondents/ prefer not to answer	9		1		3	

Table 6

Differences in profile of App users, non-users, and past users (N=125)

Characteristics	*App users (N=78)*		*App past users (N=11)*		*App non-users (N=36)*		*p-value*[*]
	N	*%*	*N*	*%*	*N*	*%*	
Gender							
Male	27	38.6	1	10.0	11	31.4	0.342
Female	43	61.4	9	90.0	24	68.6	
Non-respondents/ prefer not to answer	8		1		1		
Age							
18-34 years	12	17.1	1	10.0	8	22.8	0.726
35-54 years	50	71.5	9	90.0	24	68.6	
55+	8	11.4	0	0.0	3	8.6	
Non-respondents/ prefer not to answer	8		1		1		
Country of Birth							
India	62	87.4	9	90.0	31	88.7	1.000
Non-India	9	12.6	1	10.0	4	11.3	
Non-respondents/ prefer not to answer	7		1		1		
Gross Family Income							
<100K	20	36.4	3	42.9	8	34.8	0.559
≥$100K and ≤200K	18	32.7	4	57.1	9	39.1	
>200K	17	30.9	0	0.0	6	26.1	
Non-respondents/ prefer not to answer	23		4		13		
Education level							
High school/College	10	14.3	1	10.0	4	11.8	0.558
Bachelor's degree	17	24.3	4	40.0	13	38.2	
Graduate or higher	43	61.4	5	50.0	17	50.0	
Non-respondents/ prefer not to answer	8		1		2		
Occupation							
Employed	58	84.1	9	90.0	26	74.3	0.500
Student	6	8.7	1	10.0	3	8.6	
Not employed	5	7.2	0	0.0	5	14.3	
Other	0	0.0	0	0.0	1	2.8	
Non-respondents/ prefer not to answer	9		1		1		
Perceived health status							
Rather poor	1	1.4	0	0.0	0	0.0	0.190
Good	30	42.3	4	40.0	22	62.9	

	Very good/Excellent	407	56.3	61	60.0	131	37.1	
	Non-respondents/ prefer not to answer	7		1		1		
Chronic diseases								
	Yes	154	21.7	28	20.0	21	6.1	0.271
	No	549	78.3	81	80.0	313	93.9	
	Non-respondents/ prefer not to answer	9		1		3		

*Chi-square test is used to compare gender, country of birth, occupation and chronic diseases by group; Kruskal-Wallis test is used to compare age, gross family income, education level and perceived health status by group.

Table 7

Motivations of usage of health apps (N=78)

Items	***Not at all, n (%)***	***Mildly, n (%)***	***Somewhat, n (%)***	***Rather strongly, n (%)***	***Very strongly, n (%)***	***Not reported***
Know myself better and monitor changes in things that I consider important for my health	4 (6.0)	3 (4.5)	10 (14.9)	20 (29.8)	30 (44.8)	11
Break a bad habit related to my health	15 (24.6)	9 (14.7)	12 (19.7)	11 (18.0)	14 (23.0)	17
Give me daily encouragement toward reaching my personal health and wellness goals	1 (1.4)	5 (7.2)	14 (20.4)	17 (24.6)	32 (46.4)	9
Monitor progress made in my athletic training	10 (16.4)	5 (8.2)	21 (34.4)	14 (23.0)	11 (18.0)	17
Better follow the treatment plan prescribed by my physician or another health professional	27 (43.5)	5 (8.1)	12 (19.4)	8 (12.9)	10 (16.1)	16
Monitor one or more issues related to one or more chronic illnesses	23 (37.7)	9 (14.8)	12 (19.7)	7 (11.5)	10 (16.3)	17
Maintain or improve my autonomy to live independently in my home	20 (33.3)	10 16.7)	10 (16.7)	8 (13.3)	12 (20.0)	18
Help me take my medication on time as it was prescribed	37 (60.7)	6 (9.8)	5 (8.2)	5 (8.2)	8 (13.1)	17
Reduce the number of times I need to see my doctor	15 (25.0)	6 (10.0)	23 (38.3)	7 (11.7)	9 (15.0)	18
Improve communication with my physician or another health professional	18 (29.5)	9 (14.8)	13 (21.3)	10 (16.4)	11 (18.0)	17

Table 8

Users' appreciation of mobile health apps (N=78)

Variable and items	*Strongly disagree , n (%)*	*Somewhat disagree, n (%)*	*Neutral, n (%)*	*Somewhat agree, n (%)*	*Strongly agree, n (%)*	*Not reported*
Perceived usefulness						
I have maintained or improved my health condition	2 (3.3)	2 (3.3)	17 (27.8)	18 (29.5)	22 (36.1)	17
I am more informed about my health	1 (1.6)	4 (6.3)	15 (23.8)	17 (27.0)	26 (41.3)	15
My knowledge of my health condition has improved	1 (1.6)	5 (7.8)	16 (25.0)	17 (26.6)	25 (39.0)	14
I feel more confident taking care of my health	1 (1.6)	10 (15.6)	13 (20.3)	21 (32.8)	19 (29.7)	14
I am more autonomous in the management of my health	2 (3.2)	3 (4.8)	16 (25.8)	17 (27.5)	24 (38.7)	16
I feel less anxious about my health.	4 (6.3)	11 (17.5)	21 (33.3)	11 (17.5)	16 (25.4)	15
I have more informed discussions with my doctor	4 (6.3)	4 (6.3)	16 (25.4)	21 (33.4)	18 (28.6)	15
Perceived ease of use						
I find it easy to use my apps	4 (6.3)	1 (1.6)	2 (3.1)	24 (37.5)	33 (51.5)	14
I find my apps user-friendly	5 (7.4)	2 (2.9)	9 (13.2)	28 (41.2)	24 (35.3)	10
Learning how to use to use my apps was easy	3 (4.6)	4 (6.2)	7 (10.8)	22 (33.8)	29 (44.6)	13
The information provided stored in the mobile apps is easy to understand and interpret.	2 (3.1)	3 (4.7)	8 (12.5)	25 (39.1)	26 (40.6)	14
User satisfaction						
I am satisfied with the use of apps	7 (9.9)	5 (7.0)	16 (22.5)	24 (33.8)	19 (26.8)	7
I am pleased with my use of apps.	6 (8.7)	3 (4.4)	21 (30.4)	21 (30.4)	18 (26.1)	9
I am delighted with my use of apps	6 (9.1)	7 (10.6)	21 (31.8)	22 (33.3)	10 (15.2)	12
Confirmation of initial expectations						
My expectations concerning how I would use my app(s) have been confirmed so far	0 (0.0)	0 (0.0)	17 (26.6)	29 (45.3)	18 (28.1)	14
	3 (4.8)	3 (4.8)	14 (22.1)	16 (25.4)	27 (42.9)	15

Using my apps turned out to be easier than I first thought	4 (6.5)	0 (0.0)	10 (16.1)	22 (35.5)	26 (41.9)	16
There are more benefits to using my apps than I first thought						
Intention to continue using						
I have every intention of continuing to use health app(s) in the future	1 (1.6)	1 (1.6)	7 (11.3)	25 (40.3)	28 (45.2)	16
I will continue to use health app(s) to monitor different aspects of my health	1 (1.6)	2 (3.1)	10 (15.6)	18 (28.1)	33 (51.6)	14
I have no intention of stopping my use of health app(s) in the future	1 (1.6)	1 (1.6)	14 (22.2)	16 (25.4)	31 (49.2)	15

Note. The variation in *sample size* is due to the non-response to some of the items of the scales.

Table 9

Descriptive statistics and Cronbach's alpha coefficients for the scales for apps (N=78)

Scale	*Sample size*	*Mean (SD) 1-5*	*Alpha*	*Number of items*
Perceived usefulness	65	3.8 (0.8)	0.89	7
Perceived ease of use	69	4.0 (1.0)	0.89	4
Confirmation of initial expectations	64	4.0 (0.8)	0.80	3
User satisfaction	71	3.5 (1.0)	0.81	3
Intention to continue using	64	4.2 (0.8)	0.86	3

Note. The variation in *sample size* is due to the non-response to some of the items of the scales. Mean is calculated from the completed responses to the items in the scales

Table 10

Pearson correlation coefficients between variables for mobile health apps (N=78)

Variables	***Perceived Ease of use***	***Perceived usefulness***	***User satisfaction***	***Intention to continue using***	***Confirmation of initial expectations***
Perceived Ease of use	1	0.53**	0.72**	0.65**	0.64**
Perceived usefulness	0.53**	1	0.59**	0.70**	0.71**
User satisfaction	0.72**	0.59**	1	0.60**	0.53**
Intention to continue using	0.65**	0.70**	0.60**	1	0.74**
Confirmation of initial expectations	.64**	0.71**	0.53**	0.74**	1

Note. ** Correlation is significant at the 0.01 level (2-tailed)

Table 11

Users' appreciation of connected care technologies (N=47)

Scale name and items	***Strongly disagree, n (%)***	***Somewhat disagree, n (%)***	***Neutral, n (%)***	***Somewhat agree, n (%)***	***Strongly agree, n (%)***	***Not reported***
Perceived usefulness						
I have maintained or improved my health condition	0 (0.0)	2 (5.7)	6 (17.1)	13 (37.1)	14 (40.1)	12
I am more informed about my health	1 (2.8)	1 (2.8)	3 (8.3)	12 (33.3)	19 (52.8)	11
My knowledge of my health condition has improved	1 (2.8)	3 (8.6)	5 (14.3)	12 (34.3)	14 (40.0)	12
I feel more confident taking care of my health	1 (2.9)	4 (11.4)	6 (17.1)	12 (34.3)	12 (34.3)	12
I am more autonomous in the management of my health	1 (2.8)	1 (2.8)	9 (25.0)	13 (36.1)	12 (33.3)	11
I feel less anxious about my health.	1 (2.9)	3 (8.6)	7 (20.0)	13 (37.1)	11 (31.4)	12
I have more informed discussions with my doctor	0 (0.0)	3 (8.6)	7 (20.0)	12 (34.3)	13 (37.1)	12
Perceived ease of use						
I find it easy to use my wearables or smart devices	1 (2.8)	2 (5.6)	4 (11.1)	10 (27.8)	19 (52.7)	11
I find my wearables or smart devices user-friendly	2 (5.3)	0 (0.0)	6 (15.8)	8 (21.1)	22 (57.8)	9
Learning how to use to use my wearables or smart devices was easy	2 (5.3)	0 (0.0)	4 (10.5)	10 (26.3)	22 (57.9)	9
The information provided by my smart devices for health is easy to understand and interpret.	2 (5.4)	2 (5.4)	4 (10.8)	12 (32.4)	17 (46.0)	10
User satisfaction						
I am satisfied with the use of my wearables or smart devices	2 (5.1)	0 (0.0)	6 (15.4)	9 (23.1)	22 (56.4)	8
I am pleased with the use of my wearables or smart devices.	3 (7.9)	1 (2.6)	2 (5.3)	17 (44.7)	15 (39.5)	9
	3 (7.3)	4 (9.8)	4 (9.8)	14 (34.1)	16 (39.0)	10

I am delighted with the use of my wearables of smart devices.						
Confirmation of initial expectations						
My initial expectations concerning my use of wearables or smart devices have been confirmed so far	1 (2.7)	1 (2.7)	7 (18.9)	11 (29.8)	17 (45.9)	10
Using my wearables or smart devices turned out to be easier than I first thought	1 (2.8)	1 (2.8)	9 (25.0)	7 (19.4)	18 (50.0)	11
There are more benefits to using my wearables or smart devices than I first thought	1 (2.8)	1 (2.8)	4 (11.1)	13 (36.1)	17 (47.2)	11
Intention to continue using						
I have every intention of continuing to use wearables or smart devices in the future	1 (2.9)	1 (2.9)	3 (8.6)	13 (37.0)	17 (48.6)	12
I will continue to use wearables or smart devices to monitor different aspects of my health	1 (2.9)	1 (2.9)	3 (8.6)	9 (25.6)	21 (60.0)	12
I have no intention of stopping my use of wearables or smart devices in the future	1 (2.9)	1 (2.9)	4 (11.4)	5 (14.2)	24 (68.6)	12

Note. The variation in *sample size* is due to the non-response to some of the items of the scales

Table 12

Cronbach's alpha coefficients for the scales for smart and connected devices (N=47)

Scale	***Sample size***	***Mean (SD) 1-5***	***Alpha***	***Number of items***
Perceived usefulness	32	4.1 (0.9)	0.91	7
Perceived ease of use	34	4.2 (1.0)	0.89	4
Confirmation of initial expectations	32	4.2 (0.9)	0.88	3
User satisfaction	34	4.1 (1.1)	0.89	3
Intention to continue using	32	4.4 (1.0)	0.93	3

Note. The variation in *sample size* is due to the non-response to some of the items of the scales. Mean is calculated from the completed responses to the items in the scales

Table 13

Pearson correlation coefficients between variables (wearables) (N=47)

Variables	***Perceived Ease of use***	***Perceived usefulness***	***User satisfaction***	***Intention to continue using***	***Confirmation of initial expectations***
Perceived Ease of use	1	0.72**	0.78**	0.91**	0.84**
Perceived usefulness	0.72**	1	0.87**	0.80**	0.82**
User satisfaction	0.78**	0.87**	1	0.87**	0.77**
Intention to continue using	0.91**	0.80**	0.87**	1	0.84**
Confirmation of initial expectations	0.84**	0.82**	0.77**	0.84**	1

Note. **. Correlation is significant at the 0.01 level (2-tailed)

Table 14

Reasons for discontinuing mobile apps use (N=11)

Reasons		
	N	*%*
Entering data in an app is too time-consuming	2	18.2
At one point I found that I wasn't learning anything new	1	9.1
There were hidden costs associated with using the app	0	0
The app was too complicated to use	2	18.2
I had doubts about the reliability of the information generated by the app	0	0
I wasn't able to reach my goals and lost interest	1	9.1
I didn't like the idea of sharing my personal information with other people	0	0
I was worried my data would be transmitted without my permission/consent	0	0
I was worried that unauthorized third parties would make inappropriate use of my personal data	0	0
I was worried that using these apps could become an obsession	0	0
After a while, I just lost interest in this type of app	3	27.3
The app that I was using just stopped working well	1	9.1
No specific reason	5	45.5

Note. The percentages do not add up to 100 because participants could choose multiple options

Table 15

Reasons for discontinuation of smart devices (N=21)

Reasons		
	N	*%*
I found this type of object too complicated to use	1	4.8
I didn't like carrying or wearing this type of device with /on me	9	42.9
I wasn't able to attain the objectives I had set for myself, so I lost my motivation	2	9.5
This type of device didn't meet my personal expectations	2	9.5
I had acquired this type of device more out of curiosity than to make use of it	5	23.8
Capturing data with this type of device took too much of my time	1	4.8
The device(s) I had simply stopped working well	3	14.3
After a while, I just lost interest in this kind of device	8	38.1
I had doubts about the reliability of the information generated by the device(s) I was using	1	4.8
For no particular reason	6	28.6
I didn't like taking the time to synch my device with the mobile app it came with	3	14.3

Note. The percentages do not add up to 100 because participants could choose multiple options

Table 16

Reasons for not owning smart and connected devices among non-users (N=32)

Reasons		
	N	*%*
I am not interested	14	43.8
I do not know enough about the benefits of smart device(s) for health	5	15.6
I'm worried that I won't know how to make good use of them	6	18.8
I have doubts about the reliability of the measures they take	6	18.8
I feel that they would intrude on my privacy	5	15.6
I am worried that unauthorized third parties will make inappropriate use of my personal data	6	18.8
I am worried that use of these smart devices will become an obsession and a source of concern	3	9.4
I am worried of becoming overly dependent on these devices	1	3.1
Smart device(s) for health are too expensive	8	25
My physician does not seem to think they are worthwhile or has not spoken to me about them	1	3.1
None of the above	5	15.6

Note. The percentages do not add up to 100 because participants could choose multiple options

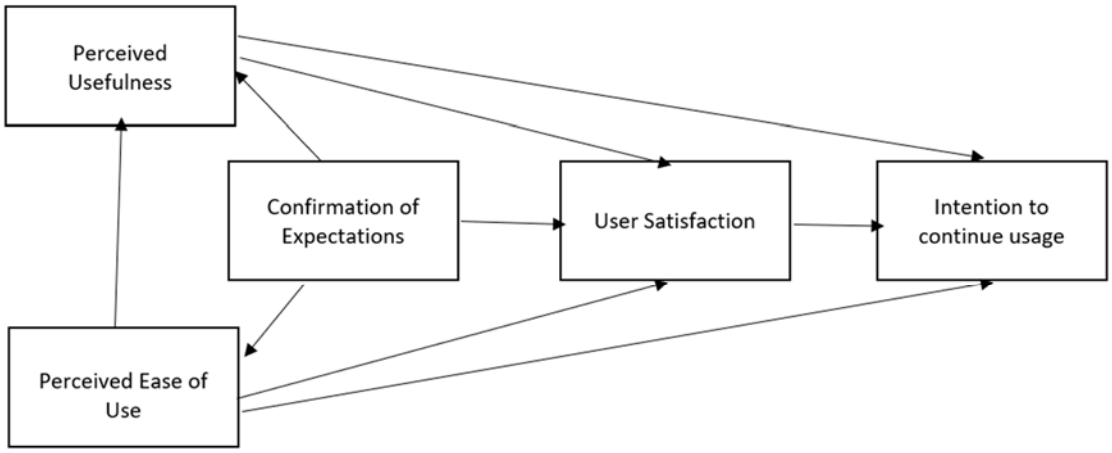

Figure 1. A conceptual framework for user acceptance or mHealth technology in South Asian adults in US. Adapted from "Diffusion of the Digital Health Self-Tracking Movement in Canada: Results of a National Survey," by G. Pare, C. Leaver, and C. Bourget, 2018, *Journal of Medical Internet Research*, *20*. e.177

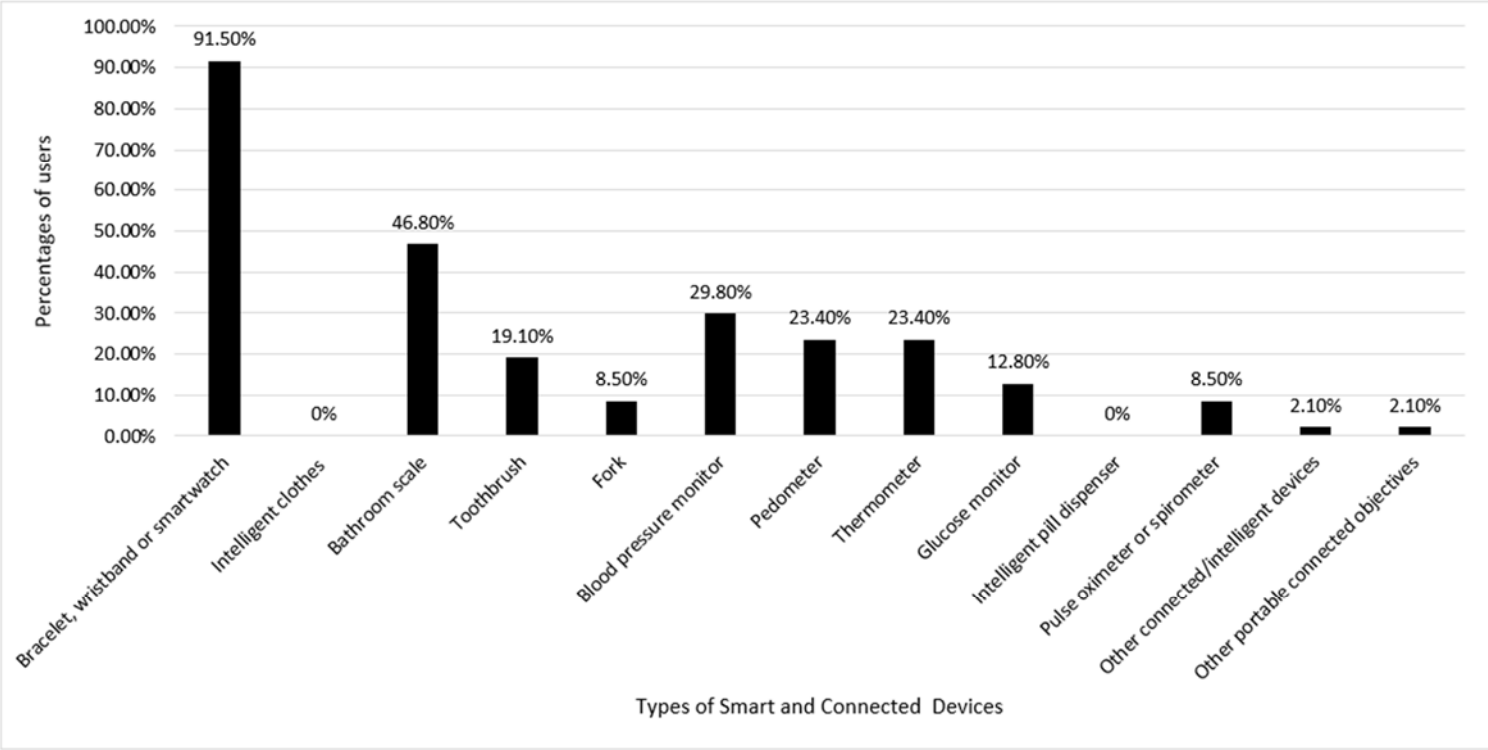

Figure 2. Types of smart and connected devices used by South Asian adults in the US

Appendix A

The University of Texas Health Science Center at Houston IRB Approval Letter

UTHealth
The University of Texas
Health Science Center at Houston

Committee for the Protection of Human Subjects
6410 Fannin Street, Suite 1100
Houston, Texas 77030

Padmavathy Ramaswamy
UT-H - SN - Nursing Graduate Studies

December 26, 2018

HSC-SN-18-1106 - *MHealth Acceptance and Usage among South Asian Adults in US*

The above named project is determined to qualify for exempt status according to 45 CFR 46.101(b)

***CATEGORY #2** : Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:*

a. information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; AND ,

b. any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

(NOTE: The exemption under Category 2 DOES NOT APPLY to research involving survey or interview procedures or observation of public behavior when individuals under the age of 18 are subjects of the activity except for research involving observations of public behavior when the investigator(s) do not participate in the activities being observed.)

CHANGES: Should you choose to make any changes to the protocol that would involve the inclusion of human subjects or identified data from humans, please submit the change via iRIS to the Committee for the Protection of Human Subjects for review.

INFORMED CONSENT DETERMINATION:
Waiver of Documentation of Informed Consent

INFORMED CONSENT: When Informed consent is required, it must be obtained by the PI or designee(s), using the format and procedures approved by the CPHS. The PI is responsible to instruct the designee in the methods approved by the CPHS for the consent process. The individual obtaining informed consent must also sign the consent document. Please note that only copies of the stamped approved informed consent form can be used when obtaining consent.

HEALTH INSURANCE PORTABILITY and ACCOUNTABILITY ACT (HIPAA):
Exempt from HIPAA

STUDY CLOSURES: Upon completion of your project, submission of a study closure report is required. The study closure report should be submitted once all data has been collected and analyzed.

Should you have any questions, please contact the Office of Research Support Committees at 713-500-7943.

Appendix B

Study Flyer

Who can Participate ?

Indians, Pakistanis, Sri Lankans, Bangladeshis, Nepalese, Bhutanese

Ages of 18 and above

Live in the Greater Houston Area

Able to read and write English

SOUTH ASIAN AMERICAN MOBILE HEALTH SURVEY

We want to hear from you...

On your use of mobile devices and apps to monitor and manage your health. Over 4.15 billion people around the world use mobile phones (Statista, 2015). We want to understand what applications and wearable mobile devices **you use** to assist you with your daily health needs, including activity performed, calories consumed and used, sleep time, heart rate etc.

What is involved

Complete an online or paper survey

The survey will take 20-25 minutes

You will be eligible to participate in a drawing for a gift card of $ 100

For more information Contact us at

Phone: 832-746-1570

Email: Padmavathy.ramaswamy@uth.tmc

Mobile health study Call 832-746-1570

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IRB NUMBER: HSC-SN-18-1106
IRB APPROVAL DATE: 12/26/2018

Appendix C

Informed Consent

INFORMED CONSENT TO TAKE PART IN RESEARCH

Study Title: Mobile health (mHealth) acceptance and usage among South Asian adults in US

Study Sponsor: Cizik School of Nursing, UT Health Science Center at Houston

Principal Investigator: Padmavathy Ramaswamy, PhD (c), MPH, MSN, RN, FNP-C

Study Contacts: Padmavathy Ramaswamy, Principal Investigator

Contacts: Padmavathy (Padma) Ramaswamy, 832-746-1570

You are being asked to participate in this study because you are of South Asian descent (with origins from Bangladesh, Bhutan, India, Nepal, Pakistan or Sri Lanka) living in the United States. I am interested in understanding what mobile health applications and smart devices you use that help you record, store and assist you with your daily health needs. I also am interested in learning your experiences with these apps and devices and why you do not use them.

If you decide to participate, please complete the **electronic survey**. Your completion of this survey is implied consent. It will take about 20-25 minutes. There are no personal **benefits** to answering the survey, but your responses will be used to design programs using mobile health technology to help improve physical activity and diet among South Asians.

We will take steps to protect your **confidentiality**. This is an anonymous survey and the researcher cannot link your name to the answers you give. All data will be stored on password-protected computes and files and access will be limited to the researchers, the UT Health review board responsible for protecting human participants, and regulatory agencies.

Upon completion of the survey, as a token of appreciation you will have the option to be entered into a raffle for a $100 gift card. If you choose to be entered into the raffle, after you submit the survey, you will be directed to enter your e-mail address which will not be linked to your survey responses. At the end of the data collection period, the raffle will take place, the winner notified and all e-mail addresses will be destroyed.

Your participation in this study is **voluntary**. Your decision whether or not to participate will not prejudice your future relationships with UT Health Cizik School of Nursing. If you decide to participate, you are free to discontinue participation at any time without prejudice.

If you have any questions about the study, you can reach Padmavathy Ramaswamy (Investigator) at the following number: (832)-746-1570. If you have any questions about your participation in this research, you can call the Institutional Review Board (IRB) at 713-500-7943. The IRB is a committee that has reviewed and approved this research study (HSC-SN-18-1106).

Appendix D

mHealth Survey Instrument

MHealth Survey Instrument

Section 1. Background

Q1a. Do you own any of the following mobile devices?

	Yes	No
a) A smartphone that can be used to download mobile applications (apps)* (for example: Apple iPhone, Samsung Galaxy, Google Nexus, Microsoft Lumia, Sony Xperia)	1 ☐	0 ☐
b) A digital tablet that can be used to download mobile applications (apps)* (for example: Apple iPad, Samsung Galaxy Tablet, Google Nexus Tablet, Sony Xperia Tablet)	1 ☐	0 ☐

**A mobile application or "app" is a program, whether free or not, that can be downloaded to a smartphone or digital tablet to perform one or more specific functions.*

IF THE ANSWERS TO a) AND b) ARE BOTH 0, GO TO Q13a, OTHERWISE CONTINUE

Q1b. Generally speaking, how often do you access the Internet using your smartphone and/or digital tablet, for example to read the news, go on Facebook, check the weather forecast or listen to the radio?

Many times each day	7 ☐
A few times each day	6 ☐
Once a day	5 ☐
3 to 5 times per week	4 ☐
1 to 2 times per week	3 ☐
2 to 3 times per month	2 ☐
Once a month or less	1 ☐
I never access the Internet on my mobile device(s)	99 ☐

CONTINUE

Section 2. Mobile Apps

Q2. Do you have one or more mobile apps on your smartphone or digital tablet to help you monitor certain aspects of your health or well-being (e.g. your weight, your dietary habits, the quality of your sleep, your mood, your physical activity, your blood pressure, your blood sugar level)?

Yes	1 ☐	**CONTINUE**
No	0 ☐	**GO TO Q13a**

Q3. Have you, in the last 3 months, used at least one health or well-being mobile app?

Yes	1 ☐	**GO TO Q5**
No	0 ☐	**CONTINUE**

PRIMARY STUDY SAMPLE CRITERIA: ANSWERS TO Q3 = 1 'YES'; and/or Q13C= 1 'YES, and I use them' or 2 'YES, but I have stopped using them' . Sample Completes (Target) N = 1000

Q4. Indicate the reason or reasons why you have not used this type of mobile app in the last three months. **Please check all the boxes that apply to your personal situation.**

RANDOM ROTATION EXCEPT FOR ITEM "M," WHICH SHOULD ALWAYS BE LAST	**Checked=1; otherwise=0**
a) Entering data (e.g. on weight, distance covered, blood sugar level) in an app is too time-consuming.	☐
b) At one point I found that I wasn't learning anything new.	☐
c) There were hidden costs associated with using the app.	☐
d) The app was too complicated to use.	☐
e) I had doubts about the reliability of the information generated by the app.	☐
f) I wasn't able to reach my goals and lost interest.	☐
g) I didn't like the idea of sharing my personal information with other people.	☐
h) I was worried my data would be transmitted without my permission/consent.	☐
i) I was worried that unauthorized third parties would make inappropriate use of my personal data.	☐

j) I was worried that using these apps could become an obsession.	☐
k) After a while, I just lost interest in this type of app.	☐
l) The app that I was using just stopped working well.	☐
m) No specific reason.	☐

GO TO Q13a

Q5. **In total,** how many health or well-being mobile apps have you used in the last 3 months?

1	1 ☐
2	2 ☐
3	3 ☐
4	4 ☐
5	5 ☐
6	6 ☐
7	7 ☐
8	8 ☐
9	9 ☐
10 or more	10 ☐
I don't know	99 ☐

CONTINUE

Q6. How long have you been using these apps?

Less than 3 months	1 ☐
Between 3 and 6 months	2 ☐
Between 6 and 12 months	3 ☐
Between 1 and 2 years	4 ☐
Between 2 and 5 years	5 ☐
I don't remember exactly	99 ☐

CONTINUE

Q7. Concerning your health and well-being, which of the following items do the apps you currently use help you with …?

Please check all the boxes that apply to your personal situation.

RANDOM ROTATION	Checked=1; otherwise=0
a) Competition and performance in sports For example: training guides, as a record of sports performance; calculations of distance covered or calories burned.	☐
b) Regular physical activity For example: exercise guides/routines; advice on leading a physically active life (being more active); as a record of physical activity; step counter, calories burned.	☐
c) Nutrition and eating habits For example: guides/programs/tools for balanced nutrition; meal calorie calculator.	☐
d) Weight-related information For example: Monitoring weight or waistline; calculator of body mass index.	☐
e) Sleep For example: monitoring sleep quality and/or hours slept; advice/tools for better sleep – music, alarms, etc.; monitoring sleep conditions, such as snoring or sleep apnea.	☐
f) Cardiovascular, lung or respiratory airway health For example: tools/advice for monitoring blood pressure, heart rate, pulse, asthma, oxygen levels	☐
g) Diabetes and other metabolism-related conditions For example: sugar, cholesterol	☐
h) Use of medication For example: monitoring medication use; identifying side effects or contraindications	☐
i) Sexual and reproductive health For example: Women: menstrual cycle; guides/advice on monitoring a pregnancy or the postnatal period. Men: guides/advice for sexual health	☐
j) Mental and emotional health For example: monitoring mood/emotional state; stress management; guides/tools for meditation/relaxation or motivation; monitoring/guides/tools for memory, attention, cognitive skills	☐
k) Dental health	☐
l) Tobacco dependence For example: monitoring/guides/tools for reducing or ending tobacco consumption	☐
m) Alcohol and drugs For example: monitoring/guides/tools for monitoring goals to reduce alcohol intake, support harm reduction or abstinence strategies to reduce or end alcohol or drug consumption	☐

FOR EACH ITEM CHECKED IN Q7, ASK Q8 [Single Question per page, with Q8 Prompted if item =1]

Q8. How often do you update your data on this aspect of health or well-being using your mobile app(s)?

Many times each day	7 ☐
A few times each day	6 ☐
Once a day	5 ☐
3 to 5 times per week	4 ☐
1 to 2 times per week	3 ☐
2 to 3 times per month	2 ☐
Once a month or less	1 ☐

CONTINUE

Q9. Generally speaking, to what extent do each of the following items encourage you to use one or more apps to better monitor your health or well-being?

RANDOM ROTATION	5 Very strongly	4 Rather strongly	3 Somewhat	2 Mildly	1 Not at all
a) Know myself better and monitor changes in things that I consider important for my health (e.g. weight, physical activity, sleep, etc.)	☐	☐	☐	☐	☐
b) Break a bad habit related to my health	☐	☐	☐	☐	☐
c) Give me daily encouragement toward reaching my personal health and wellness goals	☐	☐	☐	☐	☐
d) Monitor progress made in my athletic training	☐	☐	☐	☐	☐
e) Better follow the treatment plan prescribed by my physician or another health professional	☐	☐	☐	☐	☐
f) Monitor one or more issues related to one or more chronic illnesses (e.g. diabetes, high blood pressure, asthma, obesity)	☐	☐	☐	☐	☐
g) Maintain or improve my autonomy to live independently in my home (e.g. preparing meals, reminders for daily activities and routines, like grocery shopping))	☐	☐	☐	☐	☐
h) Help me take my medication on time as it was prescribed					
i) Reduce the number of times I need to see my doctor	☐	☐	☐	☐	☐
j) Improve communication with my physician or another health professional	☐	☐	☐	☐	☐

CONTINUE

Q10. Do you ever share the data on health and well-being recorded in your app(s) with other people?

Yes	1 ☐	**CONTINUE**
No	0 ☐	**GO TO Q12**
Prefer not to answer	88 ☐	**GO TO Q12**

Q11. With whom do you usually share the data on health and well-being recorded in your mobile apps? **Please check all the boxes that apply to your personal situation.**

RANDOM ROTATION EXCEPT FOR ITEM "G," WHICH SHOULD ALWAYS BE LAST	**Checked=1; otherwise=0**
a) Family members (e.g. spouse, brother/sister, parent, child)	☐
b) Friends	☐
c) My family doctor at my regular place of care	☐
d) A nurse at my regular place of care	☐
e) My pharmacist	☐
f) Nutritionist	☐
g) My counselor or therapist supporting my mental health	☐
h) My personal trainer (coach)	☐
i) Other users of the same mobile app	☐
j) Individuals or groups on social media	☐
k) Someone else – please specify:	☐

CONTINUE

Q12. To what extent do you agree or disagree with each of the following statements?

RANDOM ROTATION	1 Strongly disagree	2 Somewhat disagree	3 Neutral	4 Somewhat agree	5 Strongly agree
a) I am satisfied with my use of apps	☐	☐	☐	☐	☐
b) I am pleased with my use of apps	☐	☐	☐	☐	☐
c) I am delighted with my use of apps	☐	☐	☐	☐	☐
d) Learning how to use my app(s) was easy	☐	☐	☐	☐	☐
e) I find my app(s) user-friendly	☐	☐	☐	☐	☐
f) The information provided by my app(s) is easy to understand and interpret	☐	☐	☐	☐	☐
g) In general, I find it easy to use my app(s)	☐	☐	☐	☐	☐
h) Using my app(s) turned out to be easier than I first thought	☐	☐	☐	☐	☐
i) There were more benefits to using my app(s) than I first thought	☐	☐	☐	☐	☐
j) My expectations concerning how I would use my app(s) have been confirmed so far	☐	☐	☐	☐	☐
k) Thanks to my app(s), I have learned to be better informed about my health	☐	☐	☐	☐	☐
l) My use of app(s) allows me to be more autonomous in the management of my health and well-being	☐	☐	☐	☐	☐
m) I have maintained or improved my health status by using apps	☐	☐	☐	☐	☐
n) Overall health apps have proved very useful in my life	☐	☐	☐	☐	☐
o) I have every intention of CONTINUING to use health app(s) in the future	☐	☐	☐	☐	☐
p) I have no intention of stopping my use of health app(s)	☐	☐	☐	☐	☐
q) I will CONTINUE to use apps to measure, on my own, different aspects of my health and well-being	☐	☐	☐	☐	☐
r) Because of my use of health apps, I feel less anxious about my health.	☐	☐	☐	☐	☐
s) Because of my use of health apps, I feel I can have more informed discussions with my doctor.	☐	☐	☐	☐	☐
t) Because of my use of health apps, I feel more confident taking care of my health	☐	☐	☐	☐	☐
u) Because of my use of health apps, my knowledge of my health has improved	☐	☐	☐	☐	☐

CONTINUE

Section 3. Health and Well-Being Smart Connected Devices

Q13a.

The following questions deal with smart connected devices that are used to monitor health and well-being. They are electronic objects that, like those shown below, capture data on different aspects of one's health and well-being, such as pulse, weight, athletic performance, sleep quality, body temperature and blood pressure, and synch via WiFi or bluetooth with an app on your mobile smartphone or digital tablet or plug in and synch directly with an application or program on your desktop computer for visual display, monitoring, tracking, and/or analysis.

Before today, had you ever heard about smart devices for health and well-being?

Yes	1 ☐	**CONTINUE**
No	0 ☐	**IF Q3 = 0, GO TO Q20, OTHERWISE GO TO Q24**

Q13b. How familiar are you with smart devices for health and well-being?

Not much at all	Slightly	Somewhat	Very	Extremely
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

CONTINUE

Q13c. Do you have one or more smart devices or wearables for health and wellbeing that capture data related to your health and well-being?

YES, and I use them	1 ☐	**CONTINUE**
YES, but I have stopped using them	2 ☐	**GO TO Q13e**
YES, but I have never used them	3 ☐	**IF Q3 = 0, GO TO Q20**
NO	4 ☐	**GO TO Q17**

Q13d. How long have you been using a smart device/wearable for health and well-being?

Less than 3 months	1 ☐
Between 3 and 6 months	2 ☐
Between 6 and 12 months	3 ☐
Between 1 and 2 years	4 ☐
Between 2 and 5 years	5 ☐
I don’t really remember	99 ☐

GO TO Q14

13e. Why did you stop using the smart device you have? **Check all the reasons that apply to your personal situation.**

RANDOM ROTATION EXCEPT FOR ITEM "K," WHICH SHOULD ALWAYS BE LAST	Checked=1; otherwise=0
a) I found this type of object too complicated to use.	☐
b) I didn't like carrying or wearing this type of device with /on me.	☐
c) I wasn't able to attain the objectives I had set for myself, so I lost my motivation.	☐
d) This type of device didn't meet my personal expectations.	☐
e) I had acquired this type of device more out of curiosity than to make use of it.	☐
f) Capturing data with this type of device took too much of my time.	☐
g) The device(s) I had simply stopped working well.	☐
h) After a while, I just lost interest in this kind of device	☐
i) I had doubts about the reliability of the information generated by the device(s) I was using.	☐
j) For no particular reason.	☐
k) I didn't like taking the time to synch my device with the mobile app it came with	☐

GO TO QUESTION 24

Q14. How many smart devices for health and well-being do you currently own?

1	1 ☐
2	2 ☐
3	3 ☐
4	4 ☐
5	5 ☐
6	6 ☐
7	7 ☐
8	8 ☐
9	9 ☐
10 or more	10 ☐
I don't know	99 ☐

CONTINUE

Q15a. Which of the following smart devices for health and well-being do you own? **Please check all the boxes that apply to your personal situation.**

RANDOM ROTATION EXCEPT FOR ITEMS "L" and "M," WHICH ARE ALWAYS PLACED LAST	**Checked=1; otherwise=0**
a) Bracelet, wristband, or watch	☐
b) Intelligent clothing (e.g. pants, shirt, t-shirt, socks, hat, belt, shoe soles)	☐
c) Bathroom scale	☐
d) Toothbrush	☐
e) Fork *(eating speed, calories consumed)*	☐
f) Blood pressure monitor	☐
g) Pedometer *(steps walked or run)*	☐
h) Thermometer	☐
i) Glucose monitor	☐
j) Intelligent pill dispenser	☐
k) Pulse oximeter or spirometer *(respiratory functions)*	☐
l) Other connected/intelligent devices worn using a band (e.g. worn on the head, the neck, an arm, a thigh)	☐
m) Other portable connected objects (e.g. connected optical devices, connected pendants, connected hearing aids)	☐

FOR EACH OBJECT CHECKED IN Q15a, ASK Q15b [Single Question per page, with Q8 Prompted if item =1]

Q15b. How often do you use this smart device for health and well-being?

[DISPLAY THE ITEM CHECKED IN Q15a]

Many times each day	7 ☐
A few times each day	6 ☐
Once a day	5 ☐
3 to 5 times per week	4 ☐
1 to 2 times per week	3 ☐
2 to 3 times per month	2 ☐
Once a month or less	1 ☐

CONTINUE

Q16. Indicate the extent to which you agree or disagree with each of the following statements.

RANDOM ROTATION	1 Strongly disagree	2 Somewhat disagree	3 Neutral	4 Somewhat agree	5 Strongly agree
a) I am satisfied with the use I am making of my smart device(s) for health	☐	☐	☐	☐	☐
b) I am pleased with the use I am making of my smart device(s) for health	☐	☐	☐	☐	☐
c) I am delighted with the use I am making of my smart device(s) for health	☐	☐	☐	☐	☐
d) Learning how to use my smart device(s) for health was easy	☐	☐	☐	☐	☐
e) I find my smart device(s) for health user-friendly	☐	☐	☐	☐	☐
f) The information provided by my smart device(s) for health is easy to understand and interpret	☐	☐	☐	☐	☐
g) In general, I find it easy to use my smart device(s) for health	☐	☐	☐	☐	☐
h) Using my smart device(s) for health turned out to be easier than I first thought	☐	☐	☐	☐	☐
i) There were more benefits to using my smart device(s) for health than I first thought	☐	☐	☐	☐	☐
j) My expectations concerning how I would use my smart device(s) for health have been confirmed so far	☐	☐	☐	☐	☐
k) Thanks to my smart device(s) for health, I have learned to be better informed about my health	☐	☐	☐	☐	☐
l) My use of smart device(s) for health allows me to be more autonomous in the management of my health and well-being	☐	☐	☐	☐	☐
m) I have maintained or improved my health status by using smart device(s) for heath	☐	☐	☐	☐	☐
n) Overall, smart device(s) for health have proven very useful in my life	☐	☐	☐	☐	☐
o) I have every intention of CONTINUING to use my smart device(s) for heath in the future	☐	☐	☐	☐	☐
p) I have no intention of stopping my use of smart device(s) for health	☐	☐	☐	☐	☐
q) I will continue to use smart device(s) for health to measure, on my own, different aspects of my health and well-being	☐	☐	☐	☐	☐
r) My use of smart device(s) for health, help me feel less anxious about my health.	☐	☐	☐	☐	☐
s) Because of my use of health apps, I feel I can have more informed discussions with my doctor.	☐	☐	☐	☐	☐

t) Because of my use of health apps, I feel more confident taking care of my health	☐	☐	☐	☐	☐
u) Because of my use of health apps, my knowledge of my health has improved	☐	☐	☐	☐	☐

GO TO Q20

Q17. For which of the following reasons do you not own smart devices for health and well-being? **Please check all the boxes that apply to your personal situation.**

RANDOM ROTATION EXCEPT FOR ITEM "K," WHICH SHOULD ALWAYS BE LAST	**Checked=1; otherwise=0**
a) I am not interested	☐
b) I do not know enough about the benefits of smart device(s) for health.	☐
c) I'm worried that I won't know how to make good use of them.	☐
d) I have doubts about the reliability of the measures they take.	☐
e) I feel that they would intrude on my privacy.	☐
f) I am worried that unauthorized third parties will make inappropriate use of my personal data.	☐
g) I am worried that use of these smart devices will become an obsession and a source of concern.	☐
h) I am worried of becoming overly dependent on these devices.	☐
i) Smart device(s) for health are too expensive.	☐
j) My physician does not seem to think they are worthwhile or has not spoken to me about them.	☐
k) None of the above.	☐

CONTINUE

Q18. Are you thinking about buying a health and well-being connected object in the next 12 months?

Very likely	5 ☐	**CONTINUE**
Somewhat likely	4 ☐	**CONTINUE**
Unlikely	3 ☐	**IF Q3 = 0, GO TO Q20, OTHERWISE GO TO Q24**
Very unlikely	2 ☐	**IF Q3 = 0, GO TO Q20, OTHERWISE GO TO Q24**
Not at all likely	1 ☐	**IF Q3 = 0, GO TO Q20, OTHERWISE GO TO Q24**
Don't know	99 ☐	**CONTINUE**

Q19. Which of the following smart devices for health would you be interested in acquiring in the next 12 months?

Please check all the boxes that apply to your situation.

RANDOM ROTATION EXCEPT FOR ITEMS "L" AND "M," WHICH ARE ALWAYS PLACED LAST	**Checked=1; otherwise=0**
a) Bracelet or watch	☐
b) Intelligent clothing (e.g. pants, shirt, t-shirt, socks, hat, belt, shoe soles)	☐
c) Bathroom scale	☐
d) Toothbrush	☐
e) Fork	☐
f) Blood pressure monitor	☐
g) Pedometer	☐
h) Thermometer	☐
i) Glucose monitor	☐
j) Pill dispenser	☐
k) Pulse oximeter or spirometer	☐
l) Other connected/intelligent objects worn using a band (e.g. worn on the head, around the neck or chest, an arm, a thigh)	☐
m) Other portable connected objects (e.g. connected optical devices, connected pendants, connected hearing aids)	☐

IF Q3 = 0, GO TO Q20

Section 4. Profile of the Respondent

Q20. How would you rate your current health status?

Excellent	Very good	Good	Rather poor	Very poor
5 ☐	4 ☐	3 ☐	2 ☐	1 ☐

CONTINUE

Q21. Do you suffer from one or more chronic conditions?

Yes	1 ☐	**CONTINUE**
No	0 ☐	**GO TO Q27**
Prefer not to answer	88 ☐	**GO TO Q27**

Q22. Which ones? **Please check all the illnesses that apply to your personal situation.**

RANDOM ROTATION	**Checked=1; otherwise=0**
a) Diabetes	☐
b) High blood pressure	☐
c) Obesity	☐
d) Heart disease (e.g. heart attack, congestive heart failure, arrhythmia, heart disease at birth, high cholesterol)	☐
e) Lung or respiratory airway disease (e.g. asthma, cystic fibrosis, chronic obstructive pulmonary diseases such as emphysema and chronic bronchitis)	☐
f) Cancer	☐
g) Bone or muscle disease (e.g. arthritis, rheumatism, osteoarthritis, osteoporosis, back pain)	☐
h) Disease of the nervous system (e.g. stroke, memory problems, Alzheimer's disease, Parkinson's disease, dementia, migraines, head trauma)	☐
i) Mental disorders (e.g. depression, bipolar disorder, anxiety, eating disorder, personality disorder)	☐
j) Chronic infectious disease (e.g. HIV/AIDS, viral hepatitis, tuberculosis)	☐
k) Addiction to tobacco, alcohol or drugs	☐

l) Prefer not to answer	88☐

CONTINUE

Q23. Please indicate your gender.

Female	1 ☐
Male	2 ☐
Prefer not to answer	88 ☐

CONTINUE

Q24. What is your age group?

18 to 24 years	25 to 34 years	35 to 44 years	45 to 54 years	55 to 64 years	65 to 74 years	75 years or older
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
Prefer not to answer	88 ☐					

CONTINUE

Q25. What is your country of birth?

India	1 ☐
Bangladesh	2 ☐
Pakistan	3 ☐
Sri Lanka	4 ☐
Nepal	5 ☐
Bhutan	6 ☐
United States	7 ☐

CONTINUE

Q26. What is your current primary occupation?

Full-time worker (35 hours/week or more)	1 ☐	**CONTINUE**
Part-time worker (less than 35 hours/week)	2 ☐	
Student	3 ☐	**GO TO Q28**
Looking for work	4 ☐	
At home full-time	5 ☐	
Retired	6 ☐	
Other	7 ☐	
Prefer not to answer	88 ☐	

Q27. Are you a health professional?

Yes	1 ☐
No	0 ☐

CONTINUE

Q28. Including yourself, how many adults and children (under 18 years of age) usually live in your primary residence?

Number of adults: _____ **(possible values: 1 to 8)**
Prefer not to answer 88 ☐

Number of children under the age of 18: _____ **(possible values: 1 to 20)**
Prefer not to answer 88 ☐
CONTINUE

Q29. What language(s) did you first learn at home when you were a child and that you still understand?

Hindi	1 ☐
English	2 ☐
Urdu	3 ☐
Bengali	4 ☐
Nepali	5 ☐
Dzongkha	6 ☐
Other: Please specify	7 ☐

Prefer not to answer	88 ☐

CONTINUE

Q30. What is your highest completed level of education?

Primary school	1 ☐
Secondary school	2 ☐
College	3 ☐
Undergraduate university (certificate)	4 ☐
Undergraduate university (bachelor's degree)	5 ☐
Graduate university (master's degree or graduate diploma)	6 ☐
Graduate university (doctorate)	7 ☐
Prefer not to answer	88 ☐

CONTINUE

Q31. What was your total gross family income (before income taxes) in 2017?

$19,999 or less	1 ☐
$20,000 to $39,999	2 ☐
$40,000 to $59,999	3 ☐
$60,000 to $79,999	4 ☐
$80,000 to $99,999	5 ☐
$100,000 to $200,000	6 ☐
Over $200,000	7 ☐
Prefer not to answer	88 ☐

CONTINUE

End of the study. Thank you for your participation!

Appendix E

Protocol Deviation Tracking Log

PROTOCOL DEVIATION TRACKING LOG

Study Title: mHealth Acceptance and Usage among South Asian adults living in the US

Principal Investigator: Padmavathy Ramaswamy, PhD (c), MPH, MSN, RN, FNP-C Study Coordinator: Padmavathy Ramaswamy

Subject Identifier	Date of Occurrence	Description	*Is this a UP involving risks to subjects or others?	CPHS Communication	
				Submission Date	Outcome Date
	5/9/19	Overrecruiting of 29 participants over IRB approval	No	5/23/19	5/31/19
	5/23/19	5 remaining responses (pending) populated in the dataset through Qualtrics	No	6/26/19	7/1/19

***Protocol Deviations that place the subject or others at harm should be reported to the CPHS in a timely manner.**

Appendix F

UT Health Science Center of Houston CPHS Outcome Letter Notifications

UTHealth
The University of Texas
Health Science Center at Houston

Committee for the Protection of Human Subjects
6410 Fannin Street, Suite 1100
Houston, Texas 77030

TO: Dr. Padmavathy Ramaswamy
UT-H-SN - Nursing Graduate Studies

FROM: Cynthia Edmonds, MLA
CPHS Office

DATE: May 31, 2019

RE: HSC-SN-18-1106
"MHealth Acceptance and Usage among South Asian Adults in US"

Reference number: 188171

Dear Dr. Ramaswamy

This is a confirmation letter that a protocol deviation for the above referenced study was received and reviewed. It has been determined that **No Further Formal IRB Action is Necessary**.

You have permission to use the data from the 129 survey responses but the survey needs to be removed from the website to prevent further enrollment.

Please feel free to contact the Committee for the Protection of Human Subjects (CPHS) if you have any additional questions or concerns at (713) 500-7943.

UTHealth
The University of Texas
Health Science Center at Houston

Committee for the Protection of Human Subjects
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Houston, Texas 77030

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UT-H - SN - Nursing Graduate Studies

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Appendix G

Human Subjects Protection Training: CITI Completion Report

CITI PROGRAM

Completion Date 22-Jun-2017
Expiration Date 21-Jun-2020
Record ID 23357593

This is to certify that:

Padmavathy Ramaswamy

Has completed the following CITI Program course:

Human Research (Curriculum Group)
Group 2 Social and Behavioral Researchers and Key Personnel (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

University of Texas Health Science Center at Houston

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w092255eb-262a-47f9-b06b-5446264de6c2-23357593

CURRICULUM VITAE

Padmavathy Ramaswamy, MSN, MPH, FNP-C, PhD (c)

UTHSC-SON, 6901 Bertner Avenue, Room 784

Houston, TX 77030

713-500 2039

Padmavathy.ramaswamy@uth.tmc.edu

EDUCATION	INSTITUTION/LOCATION	DATE
PhD	Cizik School of Nursing, UTHealth Science Center, Houston, Texas	08/2015 - present
Certificate – Applied Health Informatics	School of Biomedical Informatics, UT Health Science Center, Houston, TX	08/2012 – 8/2013
MSN	East Tennessee State University	07/1998-12/1999
Master of Public Health	East Tennessee State University	01/1997 – 12/1998
BSN	Armed Forces Medical College, India	07/1987 – 07/1991

LICENSURE	STATE	STATUS
Advanced Practice Nurse	TX	Active
Registered Nurse	TX	Active
Advanced Practice Nurse	KY	Inactive
Registered Nurse	KY	Inactive
Advanced Practice Nurse	TN	Inactive
Registered Nurse	TN	Inactive
Registered Nurse/Midwife	Maharashtra, India	Inactive

CERTIFICATIONS	CERTIFYING BODY/INSTITUTION	STATUS

FNP-C	ANCC	2004 – present
BLS	American Heart Association	1997 - present

PROFESSIONAL EXPERIENCE

INSTITUTION	POSITION TITLE	DATES
University of Texas HSC – SON	Instructor of Clinical Nursing	2016–present
Student Health Services, U of H	Family Nurse Practitioner	2018-present
Legacy community health services	Family Nurse Practitioner	2012 - 2016
Sealy Urgent Care and Medical Clinic	Family Nurse Practitioner	2006 – 2012
Hillcroft Physicians	Family Nurse Practitioner	2004 – 2006
HealthPoint Family Care, KY	Family Nurse Practitioner	2001 – 2004
Richmond Medical Center, KY	Family Nurse Practitioner	2000 – 2001
East Tennessee State University, TN	Registered Nurse	1997 – 1999

INTERNATIONAL EXPERIENCE

Military Hospital, Madras	Registered Nurse/Midwife	1991 - 1996

HONORS, AWARDS AND SCHOLARSHIPS

1. Sigma Theta Tau International PhD Award 2016
2. Induction into Zeta Pi Chapter of Sigma Theta Tau International 2016
3. Dean's Excellence PhD scholarship 2015
   School of Nursing, UTHealth Science Center, Houston, TX
4. Normal P. Barker Memorial Scholarship 1998
   School of Nursing, East Tennessee State University, Johnson City, TN
5. Outstanding Academic Achievement Award Winner 1998-1999
   East Tennessee State University, Johnson City, TN
6. Outstanding Academic Achievement Award Winner 1997-1998
   East Tennessee State University, Johnson City, TN
7. Prime Project Grant at the Veterans Affairs Medical Center 1999
   Mountain Home, Tennessee

POSTERS/PRESENTATIONS/PUBLICATIONS

Posters:

1. **Ramaswamy, P.**, Santa Maria, D., Myneni, S., & Johnson, C. (2019). mHealth Acceptance and Usage among South Asian Adults in U.S. Poster session presented at

Sigma Theta Tau's 30th International Nursing Research Congress held July 25-29, 2019 in Calgary, Alberta, Canada.

2. **Ramaswamy, P**. (2019). Barriers and Facilitators to App and Wearable Use among Adults with Diabetes and Heart Disease: A Systematic Review, at the Harris Health System 2019 INSPIRE Nursing Symposium held April 26, 2019 in Houston, TX.

3. **Ramaswamy, P**., Joseph, N.M., & Wang, J. (2017). Health beliefs regarding cardiovascular disease risk and risk reduction: An integrative review. Poster session presented at the Clinical Excellence Conference of National Association of Indian Nurses of America (NAINA), December, 2017.

4. Joseph, N.M., **Ramaswamy, P.**, & Wang, J. (2017). Cultural factors associated with physical activity among U.S. adults: An integrative review. Poster session presented at the Clinical Excellence Conference of National Association of Indian Nurses of America (NAINA), December 2017.

Publications:

1. **Ramaswamy, P.**, Joseph, N.M., & Wang, J. (2019). *Health beliefs regarding cardiovascular disease risk and risk reduction in South Asian immigrants: An integrative review. Journal of Transcultural Nursing, 00*(0), 1-11. Published online https://journals.sagepub.com/doi/10.1177/1043659619839114

2. Joseph, N.M., **Ramaswamy, P**., & Wang, J. (2018). Cultural factors associated with physical activity among U.S. adults: An integrative review. *Applied Nursing Research, 42*, 98-110

PROFESSIONAL MEMBERSHIPS

- Indian American Nurses' Association of Greater Houston - member 2016 – present
- National Association of Indian Nurses of America – member 2008 - present
- Sigma Theta Tau International – Zeta Pi chapter – member 2016 - present
- Houston Area Nurse Practitioners (HANP) member 2004 – present
- American Nurses' Association – member 2014 – present
- Phi Kappa Phi Honor Society – member 1997-1999

ACADEMIC/PROFESSIONAL CONTRIBUTIONS

- Masters' council member – UTHSC Houston Cizik School of Nursing
- Preceptor for Nurse Practitioner and PA students
- Member, Faculty Life Council

- Academic advisor of Nurse Practitioner students
- Participant – global health hackathon at TMCx conducted by Baylor College of Medicine

COURSES TAUGHT (PRESENT TO PAST)

1. Evaluation and Application of Research (didactic) – Assistant Instructor (3 credit hours)
2. Family Nurse Practitioner II (didactic) – Co-lead (3 credit hours)
3. Family Nurse Practitioner I, II and preceptorship- Clinical instructor (2-6 credit hours)
4. Applied Health informatics for RN-BSN students (3 credit hours)
5. Advanced Practice role in population health (3 credit hours)
6. Advanced physical exam and differential diagnosis – practicum (2 credit hours)
7. Simulation for Nurse Practitioner students
8. Interprofessional education in collaboration with various UTHealth schools including McGovern School of Medicine, School of Public Health, School of Dentistry, School of Biomedical informatics and Cizik School of Nursing.