

Mhealth on Campus: Assessing Undergraduates' Attitudes and Utilization of Mobile Health Applications

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Abstract

Mhealth is rapidly becoming a valuable tool to increase knowledge and skills that contribute to healthy behaviors. Currently, little is known about college students' ownership and use of health apps. The primary purpose of this study was to investigate undergraduates' mhealth app usage and views. A secondary purpose was to identify any subgroup differences in mobile app use to determine who is more likely to use health apps. After surveying 1,487 students, results indicated most students own a smartphone (65.8%) or a smart device (65.4%); however, only 17% reported owning a health app. A chi-square goodness of fit test was found to be significant ($p=.0214$) for race with 21% of non-whites owning health apps compared to 16% of white, non-Hispanics. Additionally, it was found that students possessing apps related to their location (weather, news...) were more likely to be interested in a health app that incorporated local and campus resources. These findings are of particular relevance as college campuses seek to increase health outcomes of their students in general and as a means to increase retention. Developing mobile health apps incorporating campus resources, a social element, and local incentives may be an effective way to improve the health of college students.

Key Words: mhealth, health education, college students

Introduction

Mobile health technology has grown dramatically in recent years due largely to the popularity of smart devices. A smart device is an electronic mobile computing device, such as a smartphone, e-reader (i.e. Kindle), tablet (i.e. iPad), iPod Touch, etc.¹ Smart devices are capable of many functions, including checking email; creating, reviewing, and sharing documents; note-taking; communicating via voice and video; internet browsing; reading; GPS navigating; etc.¹ A smartphone is an enhanced device combining smart device functions with a mobile phone, allowing for calling and messaging and typically offer microprocessors, mp3 players and digital cameras.^{2,3} According to the 2010 Pew Internet and American Life Project⁴, 85% of U.S. adults own a cell phone, and of those 35% own a smartphone. Close to one-quarter of smartphone owners use their phone to do most of their online browsing and 15% have used their phone to access health information. The study also found that 1 in 4 adults track their own health data online and 48% of smartphone users look for information about doctors or other health professionals online, compared with 31% of internet users who do not have mobile access.

Along with the increased use of smartphones the overall usage of apps is also on the rise in the United States. Purcell, Entner and Henderson^{5(p2)} define apps as "end-user software applications that are designed for a cell phone operating system and which extend the phone's capabilities by enabling users to perform particular tasks." Currently, there are more than 250,000 iPhone apps, more than 30,000 Android apps, and several thousand Blackberry apps.⁶ As mobile apps are seeping into every aspect of life, it seems only natural that they would become pervasive in the health sector. According to the Advisory Board Company,⁷ from February-September 2010 Google increased their health-related apps by 156.6% to a total of 1,296, BlackBerry increased by 141.4% to a total of 338, and Apple increased by 66.6% to a total of 7,136. Health app functions include counting calories, finding nutritional information, tracking workouts, improving sleep, providing health tips, relaxing, finding exercises, calculating BMI, managing personal health records, learning about health and disease, losing weight, managing menstrual cycles and tracking pregnancy.^{6,8-13}

While the Advisory Board Company¹⁴ estimated that more than one-third of smartphone users will have a health-related app by 2015, current use—according to Melnick¹⁵—is not as high as expected, especially in comparison with other app categories; only 9% of adults with smartphones have health apps.¹⁵ This is surprising as 47% of respondents in Euro RSCG Life 4D's survey affirmed that they would manage their health online if apps were available for them to do so.^{16(p17)} As with overall app use, younger and more educated users are also more likely to use health apps and look up health information on their phones.⁶ For college students, previous studies have found that cell phone use is ubiquitous and smart phone use such as the iPhone, Android, and Blackberry are increasingly common.¹⁷ The Educause Center for Applied Research (ECAR) Study of Undergraduate Students and Information Technology, 2010 report found that 62.7% of respondents (n=36,950) owned an internet-capable handheld device and two-thirds (66.6%) access the internet weekly or more often.¹⁸ While there are numerous studies that describe college students' smartphone ownership, there is a paucity of literature on college student use of mobile apps and more so for health apps.

Among college students, there are specific health issues of importance, including fatigue/sleep deprivation, lack of physical activity, poor diet, mental health issues, substance abuse issues, campus safety issues, unhealthy relationships/sexual violence, STDs and infectious diseases.¹⁹⁻²¹ Mental health issues are particularly significant, with a study by the University of Minnesota Boynton Health Service reporting that over 27% of college students are diagnosed with a mental illness.²⁰ Additionally, in the same study, almost two-fifths of students were overweight, obese or extremely obese. Moreover one-third of students reported excessive computer/internet use, with almost half of these students reporting that this use affected academic performance. Thus, improving health outcomes in these areas will be important for improving the overall health outcomes for college students in general.

Purpose

The primary purpose of this study was to investigate undergraduates' usage and views regarding mobile health applications (apps). A secondary purpose was to identify any subgroup differences in mobile app use to determine who is more likely to use health apps. Gaining more in-depth understanding of

college students' mhealth utilization and beliefs may inform the development of mobile health apps for students to more effectively increase health outcomes on campus. Specifically, mobile health apps could benefit outcomes within the previously discussed significant college health issues. Good health is particularly important for college students, as it helps them remain in school; correspondingly, obtainment of a college degree/certificate is an excellent predictor of good health and high economic status throughout the lifetime.²⁰

Methods

Design and Sample

The study population consisted of undergraduate students completing a required personal health course at a large university in the southeastern U.S. Following approval from the Institutional Review Board (IRB) of the institution, students were emailed a link to the web-based survey and were instructed to complete it within 2 weeks. Students were offered an incentive of 5 extra credit points towards their final point total and were informed that their decision to participate was voluntary, and would not involve any penalty if they chose not to participate. Of the 2,198 eligible participants 1,805 completed the anonymous survey, yielding a response rate of 82%. Of the total, 317 included missing data or reported no smartphone or mobile device use resulting in a final sample size of 1,487.

Instrument

The survey instrument measured how and to what extent students use mobile apps in general and health apps specifically. Students were asked standard demographic questions such as age, gender, race/ethnicity, and place of residence (on or off campus). The remaining questions included items to determine whether they owned a smartphone or other mobile device; mobile app purchasing behaviors; frequency and duration of mobile app use per day (on average); personal criteria for credibility of mobile health apps; and types of apps currently used. They also were asked what type of mobile health apps would be of interest to them and other college students and why they felt that way. The survey instrument was reviewed for face validity by a panel of 5 health education/technology experts and then piloted with a group of representatives of the study population, based on age, gender, race/ethnicity and place of residence, for clarity, readability, and comprehension. The final instrument was considered

a mixed format, containing 32 items, with 30 closed-ended and 2 open-ended. Participants reporting *no* current smartphone or other mobile device usage were excluded and therefore questions of psychometric internal consistency were not addressed on the overall instrument. The individuals with either smart phone or devices were asked a stable sub-cohort of specific and appropriate questions and therefore internal consistency could be checked. A standardized Cronbach's alpha was estimated at 0.7378, indicating an acceptable fit.

Data Analysis

In assessing the primary purpose of the study, how undergraduates currently use mobile health technology, data analysis was completed using a combination of PASW Statistical Package 18.0 for Macintosh. Descriptive statistics (frequencies and contingency tables) were used to assess demographics and mobile app utilization behaviors. Two sample t-tests were used to look at app download frequency and time of use between individuals with both smart device and smartphones versus groups with only one unit. Chi-square tests were used to look at rates of health app use and support between whites and non-whites as well as different groupings based on the current use of specific apps.

Lastly, the open-ended questions were extracted and transferred to MS Word. Once converted to a usable form, a list of categories was created, comments were coded into one of those categories, and a content analysis was performed. For the secondary aims of the study, we conducted a decision tree analysis utilizing SAS JMP version 9 to explore the data for potentially meaningful subgroups. Overall, the question was to determine whether there are subgroups of health app users within the current sample and to search for such groups such as those related to associations between app use and demographics (for example). The interested reader may see Cox et al.²² for an overview of this method.

Results

For all analyses, participants reporting *no* current smartphone or other mobile device usage were excluded. Of the 1,487 study participants, 75% were white, non-Hispanics, 62% were female, and 64% freshmen. Over half (54.2%) used a smartphone or another mobile device, like an iPod or iPad, and 34% used both. Further demographic characteristics of the sample are shown in Table 1.

Mobile App Download Behavior and Use

Approximately 25% of participants (n=365) downloaded a mobile app in the past 30 days and the most recent mobile app downloaded was a game (34%). The majority of students (70%) did not pay for apps; however, 29% had paid between 99 cents and \$3.00. Sixty percent of the sample reported that the most important factor when making the decision to buy an app was the price. Other considerations included reviews and ratings (16%) and ease of use (9%). With regard to frequency and duration, 50% reported using their favorite app 1-2 times per day, while 25% used their favorite app 3-5 times per day. When asked how much time was spent using an app in any given day, 55% responded less than 10 minutes and 26% responded between 10 and 30 minutes. The data were also separated into 3 groups: smartphone only users (32%), smart device only users (34%), and users of both smartphones and smart devices (34%).

It can be observed that individuals with both smartphones and devices spend significantly more time using apps than other user types, with 44% of users of both types spending 10+ minutes per day versus 35% of one product only users (p=.0033). Additionally, a two-sample t-test indicated users of both technologies downloaded significantly more app types in the past 30 days than users of a single technology (p<.0001). Furthermore, a two-sample t-test indicated users of both devices and smartphones downloaded apps more frequently than users of smart devices (p<.0001). On average, those with both smartphones and devices have the most app types (6.5), followed by those with smartphones only (5.5), and those with only smart devices have the fewest distinct app types (3.9).

Turning our attention to the secondary aims, decision tree analysis was used to look at which combination of demographics, living conditions, device ownership, and specific app use showed an increased association with the total number of app types owned. Note that about 17% of those surveyed had 10 or more apps and about 11% had no apps therefore it was of interest to specifically find the best classification of subgroups of total number of apps. A three-split decision tree model resulted in 4 unique subgroups for further inquiry; the R-square from a model using such splits was 0.707. The results of the splits are in table 2; however, an increasing pattern that starts to classify users into distinct groups is evident. On average, users with both weather and news apps tend to have an average of 10.37 distinct types of apps on their smart device.

Conversely, users with neither weather nor game apps averaged about 1 distinct type of app each. While statistical testing is almost certain to give us a small p-value for such a trend, recall that the nature of this type of analysis is such that the algorithm selects the based splits and thus we did not hypothesize a priori that use of these specific app types would create the best subgroups in terms of total number of app use.

Undergraduates' Use of Mobile Health Apps

Mobile health app use proved to be less popular than that of others. Only 255 students (17%) reported their use, 67% were female, 63% were white non-Hispanic, and 63% were freshmen. A chi-square goodness of fit test was calculated comparing the rate of mobile health app use for gender, race, and class standing; race was found to be significant (p=.0214) with 21% of non-whites owning health apps compared to 16% of whites. Reasons for not having a health app included being unaware that health apps existed, lack of interest, cost, and perception that health apps were not effective.

Similar to overall app use, 78% of the health apps downloaded were free and the most important factors to purchase an app were price (44%), positive review/ratings (26%), and achievement of a specific health goal (18%). The majority of respondents (86%), used health apps related to diet, fitness, and weight loss and when asked, "What specific health goals were you trying to achieve with the health app?", more than two-thirds stated weight loss or increasing physical activity. When asked about factors considered regarding credibility, most relied on reviews/ratings, price, recommendations from friends or family, or some combination of the three; however, 8% did not consider whether or not it was credible at all. Table 3 presents health app ownership and type, usage and purchasing behaviors.

Decision tree analysis was also used to find any subgroups of individuals with higher health app possession rates. By doing so, it was determined that the combination of demographics, living conditions, device ownership, and specific non-health app use showed an increased association with the use of health apps. A three-split decision tree created 4 subgroups listed in table 4. While there are no associations with gaming or news apps here, there are associations with download activity and the use of weather apps. However it is important to note that the fit of this decision tree was rather poor with an R-

square value much smaller than the one discussed earlier (R -Square = 0.062). Thus it would seem that owning weather apps was a much stronger indicator of owning apps in general than owning apps specific to health.

Design a Health App for Others

All ($N=1487$) respondents were asked what topic they would hypothetically choose if they were to design a health app for college students in general. Diet and physical activity was the app topic of choice with ($n=744$, 50%), followed by stress management ($n=355$, 21%), and alcohol prevention/tobacco cessation ($n=106$, 7%). Approximately 50% (760) explained their answer by sharing concerns with weight loss and fitness and the need for college students to “stay fit, get in shape, function better, and improve their overall health.” Those choosing to design a stress management app expressed that college life is stressful and students need some kind of app to “help relieve some tension” and many just “need support.”

Local Customization of a Health App

Overall, 59% of respondents indicated an interest in a community based health app while 67% showed interest in a campus based app. Given the earlier decision tree analysis indicating associations between total distinct apps and health app use with weather app use, we decided to do a formal test to determine whether there was a higher degree of interest in a campus based app among users with certain types of apps. The rates and p -values from chi-square table analyses are listed in table 5.

Discussion

Mobile health is quickly emerging as a viable option for increasing healthy behaviors in America. Despite this growth, little is known regarding how undergraduate students are currently using or desire to use mobile health apps. In the current study, 17% of the students reported mobile health app use. Reasons for not using a health app ranged from a lack of knowledge, cost, perception that health apps are ineffective and procrastination in reaching health goals or in purchasing apps. Despite the low percentage of students who currently use health apps, more than half (59%) indicated an interest in a community based health app while 67% showed interest in a campus-based app.

Based on the results of the data, health education

specialists working to develop a health app should consider the following factors: incorporating campus and community resources, cost (low-cost or free) and relating the app to physical fitness and diet. Furthermore, health apps for undergraduates should target students who use apps to get local information such as weather and local news apps. Another factor to consider is the gaming aspect of mobile apps. Incorporating features that include social ties with campus friends such as check-ins, friendly competition, the ability to “chat” or earning a small incentive may prove to be beneficial. Another feature that may be of interest is the ability to plan for a healthy day with a daily planner or log that can also be tied to a campus/community faction who in turn can offer an incentive. It may also be beneficial to include the ability to make and schedule doctor/dentist appointments or reminders for checkups.

There are many options for future research. First, this study did not explore prior use of health apps or the perceived effectiveness of current use of health apps among undergraduates. Future studies should identify specific apps and the perceived effectiveness of said apps. Second, while recent evidence suggests overall slow adoption for mobile health app use,⁶ future studies should investigate mobile health app adoption among young adults that are diverse in race, gender and geography. Studies on adoption of mhealth apps should also utilize a theory driven approach such as Roger's Diffusion of Innovation²³ or Davis' Technology Acceptance Model.²⁴ Third, while this study did not address any specific topic for a health app, future research could focus on a particular topic, especially one related to physical activity or nutrition/diet, and assess its effectiveness. Lastly, future studies should be designed to help the common user determine whether or not a health app is credible, including identification of factors and credibility designations. Similar to the assessment of a health related website, many consumers may utilize health apps that may be of little or no help and for some harmful.

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Table 1. Descriptive Characteristics of the Sample

Sample Characteristics	n/N	Percentage
<i>Smartphone/Mobile Device^a</i>		
Smartphone User	979/1487	65.8%
Mobile Device User	1048/1487	68.4%
Both	510/1487	34.2%
<i>Age^a</i>		
18	796/1487	53.5%
19	396/1487	26.6%
20	167/1487	11.2%
21 and older	128/1487	8.6%
<i>Gender^a</i>		
Female	923/1487	62.1%
Male	556/1487	37.4%
Transgender	6/1487	.4%
Missing	2/1487	.1%
<i>Race/Ethnicity^{a,b}</i>		
African-American/black	202/1487	13.6%
Caucasian/white	1111/1487	74.7%
Other	171/1487	11.5%
Missing	3/1487	.2%
<i>Class Rank^a</i>		
Freshman	948/1487	63.8%
Freshman	372/1487	25.0%
Sophomore	161/1487	10.8%
Junior/Senior	6/1487	.4%
Missing		

Notes:

- a. Participants not reporting smartphone/smart device use were excluded
- b. Other includes both white and non-white Hispanics

Table 2. Total Number of Distinct App Groups

Subgroup	Count	Mean	St. Dev
No Weather App and No Game App	406	1.01	1.23
No Weather App and Yes Game App	256	3.66	1.96
Yes Weather App and No News App	533	6.56	2.43
Yes Weather App and Yes News App	292	10.37	2.70

Table 3. Health App Ownership and Usage		
	N/n	(%)
<i>Current health app ownership</i>	255/1487	(17%)
<i>Health app used the most, past 30 days</i>		
	84/255	(32.9%)
Physical activity/fitness	46/255	(18%)
Dieting/weight loss	26/255	(10.2%)
Food-calorie counter	17/255	(6.7%)
Reference materials	11/255	(4.3%)
Stress/relaxation	11/255	(4.3%)
Symptom checker	9/255	(3.5%)
Health diary/log	9/255	(3.5%)
BMI calculator	8/255	(3.1%)
Health news	7/255	(2.7%)
Reproductive health	7/255	(2.7%)
Weather warnings	18/255	(7%)
Other	2/255	(.8%)
Missing		
<i>Most important factor for buying a health app</i>		
	112/255	(43.9%)
Price	65/255	(25.5%)
Positive reviews/ratings	47/255	(18.4%)
To achieve a specific health goal	19/255	(7.5%)
Ease of use	6/255	(2.4%)
Recommendation from friend/family	3/255	(1.2%)
Other	3/255	(1.2%)
Missing		
<i>Average amount paid for a health app</i>		
	198/255	(77.6%)
Free	10/255	(3.9%)
> \$1.00	21/ 255	(8.2%)
\$1.00 to \$1.99	13/255	(5.1%)
\$2.00 to \$2.99	5/255	(2%)
\$3.00 to \$3.99	8/255	(3.1%)
Missing		

Table 4. Factors Associated With the Use of Health Apps

Subgroup	Count	% Own Health App
No Recent Downloads and No Weather App	450	6.47%
No Recent Downloads and Weather App	331	15.71%
Recent Downloads and No Weather App	187	19.79%
Recent Downloads and Weather App	491	27.90%

Table 5. Positive support For a Campus-based Health App based on whether individuals already own a particular app.

App	Yes	No	Difference	P-value
Weather	73%	61%	12%	<0.0001
News	76%	65%	11%	0.0004
Games	70%	62%	8%	0.0012