

# Correlation of digital health use and chronic pain coping strategies

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**Background:** Digital health is an increasingly popular tool for patient engagement, having shown great success in arenas such as medication adherence, management of chronic conditions, and patient safety. Given the growth of chronic pain diagnoses, it is imperative to find new technologies to improve care for this particular population. Little research has catalogued the use of digital health in the chronic pain patient population. This manuscript's objective was to describe current patterns of digital health usage among chronic pain patients and how digital health use correlates with health care utilization and health outcomes.

**Methods:** A cross-sectional survey was administered to patients with a self-identified chronic pain diagnosis participating in 'Patients Like Me'<sup>®</sup> (PLM), an organization that directly collects data from patients experiencing chronic health conditions, with emphasis on patient-centered outcomes and experiences interacting with the health care system. Validated measures of healthcare utilization, chronic pain management, and digital health use were adapted for the survey. Digital health was defined as the use of online sites, social media, and mobile phone applications before, during, or after healthcare utilization. Descriptive statistics, chi square tests, logistic regression, and linear regression were used as appropriate for analysis.

**Results:** Among 565 respondents (mean age 51.3, 87.2% female, 45.7% publicly insured), most participants (89.5%) reported some digital health use. Females and users below the age of 50 were more likely to use multiple forms of digital health. Healthcare utilization, education level, and race/ethnicity did not correlate with digital health use. Patients using more types of digital health reported significantly higher levels of pain coping skills in the realms of social support, relaxation, and exercise.

**Conclusions:** Digital health use is common among a wide range of patients with chronic pain diagnoses. The use of multiple forms of digital health is associated with improved chronic pain coping mechanisms. Future work should explore the directional relationship between digital health tools and chronic pain coping skills, as well as which components of digital health have the most effect on chronic pain management and other patient-centered outcomes.

**Keywords:** mHealth; chronic pain; mobile applications; web browser; psychological adaptation; healthcare disparities; adult

Received: 13 July 2016; Accepted: 24 August 2016; Published: 06 September 2016.

doi: 10.21037/mhealth.2016.08.05

View this article at: <http://dx.doi.org/10.21037/mhealth.2016.08.05>

## Introduction

“Digital health”, defined as the convergence of digital technologies and healthcare, is widely promoted for patient engagement (1,2). Some digital health tools—such as websites, mobile applications, and personal health monitoring devices—have demonstrated efficacy at improving medication adherence, management of chronic conditions, and patient safety (3-7). Studies suggest that digital health is most often used by patients seeking additional information or support (8).

Chronic pain is common. Patients with chronic pain articulate frustrations about lack of engagement in their healthcare; for instance, qualitative research suggests that comprehension of patients’ individual circumstances and access to evidence about treatment options are challenges for many patients with chronic pain (9). Effective application of chronic pain coping techniques may result in lower pain and improved health outcomes (10). Digital health may be salient for patients with chronic pain-related diagnoses by overcoming barriers to care such as: access to non-pharmaceutical therapies; pain-related mobility issues; peer networking and support; awareness of alternative diagnoses and therapeutic options (11-14). It may thereby provide a possible approach for increasing patient engagement and coping skills.

It is unknown, however, whether digital health use improves coping techniques, particularly among chronic pain patients. Existing chronic pain-focused mobile applications are overly simplistic, rarely based in theory, and rarely supported by evidence (15). Little research has been done to catalogue the use of digital health in the chronic pain patient population, or to describe whether its use is associated with pain-related coping skills.

This brief report aims to describe patterns of digital health usage among chronic pain patients engaged in a popular online patient discussion forum, and to examine whether digital health use correlates with health care utilization and pain-related coping skills.

## Methods

### *Study setting*

This cross-sectional survey was administered to patients with a self-identified chronic pain diagnosis participating in ‘Patients Like Me’<sup>®</sup> (PLM), an organization that directly collects data from patients experiencing chronic health conditions, with emphasis on patient-centered outcomes

and experiences interacting with the health care system. PLM has a specified goal of sharing these data with researchers to increase healthcare research by decreasing barriers to accessing patient experiences (16). Independent institutional review board approval was obtained for the study.

### *Participant recruitment*

PLM sent out invitations to complete the survey to members who met the following eligibility criteria: age 21–64 years, residing in the US, had at least one log-in to the PLM site in the past 30 days, owned or had access to a cell phone, reported pain as a condition on their profile or had experienced chronic pain in the past 12 months. All eligible users were invited via email, by PLM, to participate in the survey. The initial survey invite was followed by an email reminder if the user had not responded within two weeks. Sampling was conducted with the goal of recruiting a survey sample of at least 15% non-White race or Hispanic or Latino ethnicity, no more than 60% female, and no less than 40% with some college or less education. The email invites for participation in the study were sent in three waves to patient panels that would help meet the predetermined sampling goals, based on PLM’s internal knowledge of their membership. Each wave included 500 invitations.

### *Survey development*

The survey consisted of validated and piloted measures relevant to chronic pain. Specific measures analyzed for this manuscript included:

- (I) Demographic information: questions about gender, race, ethnicity, education, employment and insurance status were asked. These questions and responses were adopted from similar demographic questions previously administered across multiple prior studies.
- (II) Frequency of health service use was measured using items from the National Health Interview Survey (17), asking about number of visits in the past 12 months to a primary care clinic or doctor’s office or to a hospital emergency department. Response options ranged from not used in the past 12 months to daily or almost daily use.
- (III) Pain coping was measured using the Chronic Pain Coping Inventory (CPCI) 26-item wellness subscales (which contains measures of four specific wellness-

related coping strategies) (18). This is a licensed assessment scale, with demonstrated reliability and validity (19). Wellness subscale items asked respondents on how many days in the past week they had used a list of 26 strategies to cope with their pain (response options ranged from 0 to 7 days). The items were summed and averaged to generate an overall score, as well as subscale scores for each of the wellness-related pain coping strategies: self-talk, relaxation, task persistence, exercise/stretching, and seeking social support. Higher scores correlate with better coping skills.

- (IV) Use of digital technology: respondents indicated their ownership or access to technology (such as cell-phones and computers), as well as their self-reported use of online medical resources, social media and mobile phone applications in managing their pain and health. Options for use were: before a visit to the healthcare provider, during the visit, after the visit, or no use of the technology in this way. These questions were adapted from a previously piloted survey used with emergency department patients (20). Digital health use was described in terms of types of digital health use (website, social media, mobile applications) as well as temporal use of digital health. Digital health use “of any kind” was defined as a positive response to the use of websites, social media, or mobile applications at any time point to inform health care.

**Analysis**

De-identified survey responses were transferred from the PLM database to a secure study database prior to analysis. Descriptive statistics were calculated for all variables, with continuous data reported as means with standard deviations, and proportions reported with 95% confidence intervals. To examine correlates of low (0 to 1 form of digital health used at any point in care) vs. high (2+ forms of digital health used at any point in care) digital health use, univariable logistic regression was conducted to examine its association with patient characteristics; multivariable logistic regression was then run, with level of digital health use as the dependent variable, adjusting for significant variables on the univariable regression. Finally, linear regression was conducted to explore differences in pain coping styles (for each of the CPCI wellness subscales) by digital health use, adjusting for gender and age, and including an interaction term between digital health use and age older than 50 years.

**Table 1** Descriptive characteristics of the sample (n=565)

Characteristics	N	%
<b>Demographics</b>		
Age greater than 50	317	56.1
Female	490	87.2
Non-Hispanic	529	95.1
White	498	88.1
College education or higher	209	37.3
Employed	189	33.8
Privately insured	254	45.7
<b>Health technology utilization</b>		
Uses health-related websites	448	83.7
Uses health-related social media	204	38.1
Uses health-related mobile applications	196	36.6
<b>Past-year health care utilization</b>		
<b>Emergency department use</b>		
0 visits	340	60.2
1–2 visits	148	26.2
3+ visits	77	13.6
<b>Primary care physician use</b>		
0 visits	22	3.9
1–2 visits	145	25.7
3+ visits	398	70.4
<b>Chronic pain coping inventory subscale scores (mean, SD)</b>		
Self-talk	3.8	SD 2.2
Social support	2.4	SD 2.1
Relaxation	2.1	SD 1.8
Persistence	3.7	SD 1.9
Exercise	2.3	SD 1.9

Categories are not mutually exclusive, therefore data will sum to be greater than 100%.

**Results**

A total 565 responses were obtained (122 in October 2014, 240 in January 2015, 203 in March 2015) through three waves of invitations from PLM (response rate 37.6%). Characteristics of the participants are given in *Table 1*. The mean age of the study population was 51.3 (SD =10.8). Most

**Table 2** Self-reported digital health use (n=565)

Time of use	Any technology (%)	Web (%)	Social media (%)	Apps (%)
Used ever for healthcare	479 (89.5)	448 (83.7)	204 (38.1)	196 (36.6)
Before a healthcare visit	394 (73.6)	354 (66.2)	137 (25.6)	136 (25.4)
During a healthcare visit	63 (11.8)	21 (3.9)	21 (3.9)	35 (6.5)
After a healthcare visit	361 (67.5)	291 (54.4)	127 (23.7)	143 (26.7)
Did not use for healthcare	56 (10.5)	87 (16.3)	331 (61.9)	339 (63.4)

**Table 3** Correlates of digital health use: unadjusted logistic regression (n=565)

Characteristic	OR (95% CI)
Gender (referent = male)	1.94 (1.16–3.26)*
Age (referent $\geq 50$ years)	2.05 (1.47–2.89)*
Race (referent = non-white)	1.46 (0.87–2.49)
Ethnicity (referent = non-Hispanic)	0.72 (0.32–1.59)
Education status (referent = less than college grad)	0.95 (0.68–1.35)
Employment status (referent = unemployed)	1.26 (0.81–1.95)
Insurance status (referent = uninsured)	0.69 (0.27–1.75)
ED use	1.19 (0.84–1.67)
PCP use	1.38 (0.58–3.27)
Urgent care use	1.21 (0.84–1.73)

\*, significant.

respondents were female (87.2%), non-Hispanic (95.1%), and white (88.1%). A minority of respondents reported having completed college (37.3%), being employed (33.8%), or having private insurance (45.7%). Further descriptive characteristics are in *Table 1*. Data on non-respondents was unavailable.

Most participants (89.5%) reported some digital health use (see *Table 2*). Websites were the most common form of health-related technology used (84.1%), and “apps” the least (39.4%). Although few respondents (11.8%) reported using digital health during a healthcare visit, those who did most often reported using apps (6.5%). Almost half (48.5%) reported being high utilizers of digital health (using more than one form, per our *a priori* definition).

In the unadjusted analysis, females and participants aged <50 years old were more likely to be high utilizers of digital

health (see *Table 3*). No significant association was found between high digital health use and other demographic factors, nor between digital health use and healthcare utilization.

On multivariable linear regression, high digital health use predicted higher scores for the support (intercept 1.33;  $\beta=0.53$ ; 95% CI, 0.05–1.01;  $P=0.03$ ), relaxation (intercept 1.49;  $\beta=0.53$ ; 95% CI, 0.12–0.94;  $P=0.01$ ), and exercise (intercept 2.08;  $\beta=0.54$ ; 95% CI, 0.10–0.98;  $P=0.016$ ) subscales; it did not predict higher scores on the self-talk subscale (intercept 2.81;  $\beta=0.50$ ; 95% CI, -0.02–1.01;  $P=0.06$ ) or the persistence subscale (intercept 3.80;  $\beta=0.06$ ; 95% CI, -0.39–0.51;  $P=0.26$ ). Female gender significantly predicted both higher self-talk subscale scores ( $\beta=0.96$ ; 95% CI, 0.39–1.53;  $P=0.001$ ) and relaxation scores ( $\beta=0.46$ ; 95% CI, 0.01–0.92;  $P=0.05$ ). The interaction term between age <50 years and high digital health use indicated lower coping self-talk subscale scores ( $\beta=-0.80$ ; 95% CI, -1.57–-0.02;  $P=0.05$ ) among this subgroup. Age group alone did not predict any of the CPCI subscale scores. A sensitivity analysis including a gender x digital health interaction score did not change the results appreciably, worsened model fit, and was therefore dropped.

## Discussion

This cross-sectional study of a predominantly low-income, female population experiencing chronic pain provides preliminary data supporting digital health to enhance chronic pain coping mechanisms.

Almost 90% of respondents, across demographic groups, reported use of some form of digital health. In accordance with national data, the most commonly used form was websites, but apps and social media were used by over 1/3 of respondents. This survey did not explore whether this population uses apps and social media for non-health-related purpose. Others' work suggests that the more

comfortable a patient is with a form of technology, the more likely she or he is with using that technology type to facilitate health (21,22).

All three forms of digital health were likely to be used before and after a healthcare appointment, but rarely during an appointment. These differences in usage patterns may reflect prevalent physician discomfort with, or lack of knowledge about, digital health (23-25). It is possible that opportunities exist for physicians to use digital health to enhance patient engagement during a healthcare visit. Future work should explore the utility of digital health use during a visit for patients with chronic pain diagnoses, and whether enhanced usage during an appointment would be feasible, acceptable, and effective.

In accordance with others' and our own work, younger age, but not education level or socioeconomic status, correlated with use of digital health by this population. Others' work suggests that elderly patients may have decreased comfort with technology; this disparity in usage may, however, be disappearing (26-28). Indeed, our findings support the idea that a socioeconomic "digital gap" is decreasing (if existent at all) and that digital health interventions are acceptable and used among all strata of society.

Supporting the initial study hypothesis, we observed that using more forms of digital correlated with higher levels of many well-established chronic pain coping techniques, including support, relaxation, and exercise skills. These three coping techniques were employed the least frequently by respondents; it is therefore possible that digital health has a greater influence on skills which do not already exist. Alternatively, these coping skills may be most amenable to the influence of digital health. Indeed, others' work suggests that multiple forms of digital health—ranging from Twitter to online curricula—can be effective in increasing exercise, encouraging mindfulness, and increasing distress tolerance. Some theorize that these findings are largely due to the social support environment (12).

Provocatively, patients who were both younger (<50 years old) and using multiple forms of digital health had lower self-talk coping skills. Neither digital health use nor any demographic factors predicted persistence skillsets. Patients with multiple chronic conditions may perceive digital health resources as an extra burden, and possibly even as a negative influence on mood and health status (29). It is also possible that the development of self-talk and persistence skills—often addressed through techniques such as cognitive behavioral therapy—may

require more time, practice, and formal instruction than is available through ad hoc forms of digital health. Given the age-digital health interaction, it is possible that such skills may be more likely to develop at older ages, and with more life practice or, alternatively, that younger, more digitally-dependent patients are less able to develop self-talk and persistence skills. More research is needed to better understand these associations.

Higher digital health use also did not correlate with differences in number of ED or PCP visits. In other words, digital health use was not limited to people with high utilization of the healthcare system. Nor, despite its prediction of improved coping skills, did it correlate with decreased utilization of healthcare. Future research should prospectively examine the systems-level outcomes of digital health use among patients with chronic pain, controlling for known confounders of usage.

Finally, despite others' work suggesting that women are more likely to seek out social support in the face of illness, female gender only weakly predicted improved self-talk and relaxation scores, and did not correlate at all with the other coping scales (30,31). However, our population was predominantly female, which may have decreased the power to detect differences.

### *Limitations*

Due to the cross sectional study design, only a correlation between these factors can be noted, not a causation. Because the survey was administered via PatientsLikeMe, selection bias is present as these patients are already utilizing technology in conjunction with their healthcare. Additionally, these patients' experiences may not be generalizable to the larger PLM patient population nor to the general chronic pain patient population. Finally, we did not assess the specific subtypes of digital health used (e.g., self-tracking, text-messaging, obtaining social support, etc.); nonetheless, the information about types used is a major contribution to the literature.

### **Conclusions**

Digital health usage is common among a wide range of patients with chronic pain diagnoses. The usage of multiple forms of digital health (apps, social media, and online resources) is associated with improved chronic pain coping mechanisms. Future work should examine specific purposes and uses of digital health by this population, and develop

theoretically-informed, evidence based support systems and interventions.

## Acknowledgements

We would like to thank the patients of PatientsLikeMe.com who took part in our survey, Dr. Marcy Fitz-Randolph and Dr. Emil Chiauzzi for their guidance in survey development, and Ms. Sarah Pittman for her assistance with manuscript formatting.

*Funding:* Research reported in this presentation was funded through a Patient-Centered Outcomes Research Institute (PCORI) Award #IHS-1306-02960.

## Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare. Neither the funder nor PatientsLikeMe had any involvement in data analysis or manuscript authorship.

*Disclaimer:* The views in this work are solely the responsibility of the authors and do not necessarily represent the views of the Patient-Centered Outcomes Research Institute (PCORI), its Board of Governors or Methodology Committee.

*Ethical Statement:* The study was approved by the New England Institutional Review Board (No. 120160369) and waiver of written informed consent was obtained from all participants for publication.

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doi: 10.21037/mhealth.2016.08.05

**Cite this article as:** Ranney ML, Duarte C, Baird J, Patry EJ, Green TC. Correlation of digital health use and chronic pain coping strategies. *mHealth* 2016;2:35.