Factors Associated with Older Adults' Long-Term Use of Wearable Activity Trackers

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Abstract

Background: *Wearable activity trackers (WATs) have the potential to improve older adults' health; yet, many adopters of WATs are not able to use them on a long-term basis.*

Methods: *A survey was conducted with an online panel of adults 65 and older (N = 214) to explore factors associated with long-term use of WATs, including initial adoption motivations, usage patterns, as well as differences in sociodemographic factors, health status, and activity levels.*

Results: *Results from the logistic regression analysis indicated that being a long-term WAT user was significantly associated with using a wider variety of WAT functions, wearing WAT every day, being female, exercising more frequently, having higher education, not engaging in step count competition, and not having chronic conditions.*

Conclusions: *Understanding long-term use of WATs among older adults is important given that this technology is prone to be abandoned quickly after initial adoption and such abandonment negates its potential in supporting long-term health behavior change. Findings of this study will inform innovative WAT designs that afford long-term use and offer helpful strategies for future interventions using WATs among older adults.*

Keywords: *wearable activity trackers (WATs), older adults, long-term use, logistic regression, m-health, telemedicine, e-health*

Introduction

As a tool to increase physical activity (PA) and promote an active lifestyle, commercially available wearable activity trackers (WATs) have become a rapidly expanding health-focused industry.[1] Individuals who used the device on a long-term basis reported favorable health outcomes associated with WAT use.[2,3] However, one of the main issues that have emerged with the usage of WATs and other m-health technology is the large dropout rate after initial adoption.[4–7] A survey ($N = 6{,}223$) found that more than half of the individuals discontinued using WATs within 6 months of adoption, marking 6 months as a dividing point for distinguishing between short-term and long-term use.[7] Despite a growing interest in this area of research and multiple studies that have explored the initial adoption and abandonment of WATs, relatively few quantitative studies have focused on factors related to long-term use of wearable devices.[4,5,8–10]

One of the biggest challenges of using m-health technologies to encourage individuals' self-monitoring and self-management of health is the long-term use of such devices. This study provides quantitative evidence regarding the predictors of older adults' long-term engagement with WATs. Findings of this study will contribute to understanding the long-term use of not only WATs but also related m-health technologies.

Another contribution of the present study is the focus on the older adult population. Older adults are at a high risk of chronic diseases, which can be effectively prevented and managed by PA.[11] As WAT is a tool for promoting PA,[12–14] understanding factors associated with older adults' long-term engagement with it could be especially important for reaping its health benefits for this population.

People's initial motivations for adopting WATs can be a factor in explaining long-term usage.[9] Prior literature identified motivations for wearing WATs as monitoring activities, improving fitness, improving health, and competing with family members and friends.[10] Based on motivations for adoption, one study categorized WAT users into purposive and explorative. The purposive group had clearer goals, such as achieving a healthier lifestyle and quantifying PA, while the explorative group received the device as a gift or bought it to support friends and family members.[9] Purposive users were found to be more likely to wear their WATs more frequently and for a longer time.[9] Short-term users were more likely to get the WAT from friends, partners, or companies as a gift.[5]

Older adults identify motivations such as monitoring activity, improving health, receiving social support, engaging in competition, and losing weight as reasons to start using WATs.[15] Personal motivation (i.e., having medical conditions and increasing levels of PA) and social motivation (i.e., relatedness and social competition) also contribute to long-term use of WATs.[16] Therefore, whether an individual becomes a long- or short-term WAT user depends, to a great degree, on their motivations. In this study, we investigate eight commonly identified motivations for adoption—(i) becoming more active, (ii) managing a chronic illness, (iii) losing weight, (iv) monitoring health, (v) monitoring diet, (vi) supporting a family member or friend, (vii) following doctor's recommendation, and (viii) receiving WAT as a gift—as predictors of long-term WAT use.

RQ1: How are initial motivations associated with long-term WAT usage among older adults?

Users can be categorized into different types based on their usage patterns.[5,17] First, users who wore WATs at higher frequency also used them longer.[9] Previous studies on information systems, such as mobile apps and data mining tools, have found that frequency of use was positively associated with habit and continuance intention.[18–20] Second, WATS' ability to collect various indicators of personal activity and to construct a holistic quantified self-image[21] has been found to be important for quantified selfers who are strongly motivated to gather high-quality data about themselves. Quantified selfers also used WATs for the longest time compared with other types of users.[21] Tracking multiple indicators of personal activity implies using multiple functions of WATs, which we measured in the present study. Third, using WAT to compete with others has shown inconsistent relationships with the WAT use duration. Some long-term users agree that competition provides greater motivation to exercise[2]; yet, some evidence suggests that WAT users are sensitive to individual differences based on physical conditions and lifestyle, making competition demotivating and less helpful.[22] Given this evidence, we ask:

RQ2: How are the usage patterns, operationalized as 1) the frequency of wearing WAT, 2) number of functions used, and 3) engagement with WAT-facilitated competition, associated with long-term usage of WATs among older adults?

Associations have also been found between the use and ownership of health technologies and sociodemographic and related individual factors (e.g., health status or activity level). A national survey in Australia has shown that being male, being unemployed, having lower education, and being inactive were associated with lowered odds of tracker usage (including pedometers, accelerometers, and smartphone applications).[23] A study from Canada has found that WAT use was associated with being female, being younger than 60 years, being married, having at least some postsecondary education, having a body mass index >25, and meeting recommended PA guidelines.[24] Similarly, a survey among U.S. older adults (≥65 years) found that being 65–74 years old, female, and having a higher level of education, income, and self-reported health were positively related to WAT adoption.[25] In addition, higher rates of chronic conditions among older adults hinder the usage of WATs because certain types of chronic conditions, such as arthritis, can limit mobility.[26] Thus, our third research question asks:

RQ3: How are sociodemographic and related individual factors, including sex, age, education, marital status, household income, health status (i.e., having chronic condition(s) or not), and activity levels (i.e., engaging in exercise or not) associated with the long-term usage of WATs among older adults?

Methods

This study was approved by the institutional review board at the university with which the authors are affiliated. Data were collected online between January 3 and 29, 2017. Three hundred fourteen ($N=314$) participants who have experience wearing WATs were recruited from an online panel provided by Qualtrics. Respondent's compensation was determined by panel membership. Individuals were categorized as long-term users if they reported having used a WAT for 6 months or more ($N=164$). Individuals who no longer used WAT but had used a WAT for ≤6 months in the past were categorized as short-term users ($N=51$). We did not include users who were currently using WATs but had used the WAT for <6 months as short-term users because they could become long-term users if given more time ($N=99$). Excluding missing data, our final sample included 214 participants (163 long-term and 51 short-term users).

MEASURES

Motivations for adoption. Participants rated their levels of agreement using a four-point Likert scale anchored by strongly disagree and strongly agree on questions about why they started using WATs. Items were developed after consulting relevant literature.[9] Participants evaluated eight reasons to use WAT: (i) to help me become more active, (ii) to help me improve a chronic illness, disease, or health problem that I

have, (iii) to help me lose weight, (iv) to help me monitor my health, (v) to help me monitor my diet, (vi) to support a family member or friend, (vii) someone I know has had great success using a tracker, and (viii) my doctor or another health care provider recommended that I use a tracker. Participants could provide additional reasons for adoption in an open-ended question. Factor analysis with principal component factoring and promax rotation was run to determine the factor structure of motivations for adoption. Two factors emerged: regular monitoring ("to help me become more active," "to help me lose weight," "to help me monitor my health," "to help me monitor my diet") (Cronbach $\alpha = 0.71$) and social exchange ("to support a family member or friend," "someone I know has had great success using a tracker," "my doctor or another health care provider recommended that I use a tracker") (Cronbach $\alpha = 0.65$). The eigenvalues for both factors were above one, and both factors were above the elbow of the scree plot. Factor loadings for the regular monitoring factor and social exchange factor were within the accepted range (regular monitoring: 0.48–0.83; social exchange: 0.68–0.80). The two factors accounted for 52% of the variance. Individuals' scores on these two motivations were calculated by averaging the items loaded on each factor. A third motivational factor was whether respondents obtained their WATs as a gift or purchased it themselves (1 = Gift, 0 = Purchased).

USAGE PATTERNS

We asked respondents "How often do/did you wear your tracker?" to measure the frequency of wearing WATs. Participants selected from five categories that range from "every day" to "less than once a month." Due to the limited number of participants ($N = 32$ out of 214) who selected categories other than "Every day," answers were dichotomized into "every day" and "not every day." Respondents indicated if they used any of the commonly available WAT functions such as calories burned, calories consumed, distance, elevation/stairs, heart rate, mood, sleep time, sleep quality steps, and waterproof. They also could add other functions not included in the list. We summed the number of functions that respondents selected and used the computed index as an indicator of the number of functions used. Finally, respondents were asked whether they used trackers to compete with family and friends in terms of number of steps taken daily (1 = Competing, 0 = Not competing).

SOCIODEMOGRAPHIC VARIABLES

Sex (1 = female, 0 = male), age (in years), education (1 = high school degree or less, 2 = some college, 3 = bachelor's degree, 4 = master's degree, 5 = Doctorate degree), household income (1 = <$24,999, 2 = $25,000–$49,999, 3 = $50,000– $99,999, 4 = $100,000– $199,999, 5 = $200,000 or more), and marital status (1 = married, 0 = not married) were assessed.

HEALTH STATUS AND ACTIVITY LEVELS

Participants were asked "According to the National Center for Health Statistics, a chronic health condition/disease is one lasting three or more months and generally cannot be prevented or cured with medication. Do you currently have one or more chronic health conditions and/or diseases?" (Yes = 1, No = 0.) Participants also responded to the question "How often do you exercise in a typical week?" on a five-point scale from 0 "I don't exercise" to 4 "More than five times a week."

Results

Participants from 40 states were recruited for the survey. Fitbit was the most commonly used brand (74%), followed by Garmin (13%) and Apple (6%). *Table 1* presents the descriptive statistics by different types of users.

Table 2 reports the logistic regression model predicting whether the participant was a short-term or long-term user. A test of the full model against a constant-only model was statistically significant, indicating that the predictors as a set reliably distinguished between short-term and long-term users ($\chi^2 = 114.94$, $p < 0.001$ with $df = 13$). The final model has an McFadden's adjusted R^2 of 0.37, which suggests that the model has an excellent fit.[27]

Neither of the two factors representing motivations for adoptions was significant in predicting long-term use (odds ratio [OR] = 1.84, $p > 0.05$ for regular monitoring; OR = 0.71, $p > 0.05$ for social exchange). Receiving WAT as a gift (OR = 2.29, $p > 0.05$) was also not significantly associated with the likelihood of long-term usage. Wearing WATs every day (OR = 5.26, $p < 0.01$) and using a greater number of functions (OR = 1.27, $p < 0.05$) were associated with increased likelihood of long-term usage, while engaging in competition (OR = 0.07, $p < 0.001$) was associated with decreased likelihood of long-term usage. Being female (OR = 4.30, $p < 0.01$), having a higher level of education (OR = 2.02, $p < 0.01$), and exercising more frequently (OR = 2.18, $p < 0.001$) were associated with increased likelihood of long-term usage. Having chronic condition(s) (OR = 0.31 $p < 0.05$) was associated with decreased likelihood of long-term usage.

Discussion

Long-term WAT use has the potential to improve older adults' health. Despite increasing research on adoption and

Table 1. Descriptive Statistics

	SHORT-TERM USER (≤6 MONTHS)	LONG-TERM USER (>6 MONTHS)	TOTAL	LABELS
N	51	163	214	
Motivations for adoption				
Regular monitoring	2.73 (0.44)	2.89 (0.60)	2.85 (0.57)	1–4, 1 = strongly disagree
Social exchange	2.12 (0.67)	2.04 (0.62)	2.06 (0.63)	As above
Received it as a gift	29%	45%	41%	1 = gift
Usage patterns				
Wearing WATs every day	68.6%	90.2%	85%	1 = everyday
Number of functions used	4.27 (2.42)	5.37 (2.06)	5.11 (2.19)	0–10
Engaging in competition	84%	40%	51%	1 = compete
Sociodemographic factors, health status, and activity levels				
Age	70.02 (4.20)	69.41 (6.34)	69.56 (5.90)	In years
Frequency of exercise	1.41 (1.17)	2.44 (1.26)	2.20 (1.31)	0–4, 0 = I don't exercise
Having chronic condition(s)	69%	38%	45%	1 = have chronic condition(s)
Female	43%	64%	59%	1 = female
Being married	61%	78%	74%	1 = being married
Household income				
<$24,999	18%	5%	8%	
$25,000–$49,999	37%	20%	24%	
$50,000– $99,999	33%	47%	44%	
$100,000– $199,999	10%	24%	21%	
$200,000 or more	2%	4%	3%	
Education				
High school or less	25%	10%	14%	
Some college	37%	31%	32%	
Bachelor's degree	18%	32%	28%	
Master's degree	16%	22%	21%	
Doctorate degree	4%	5%	5%	

WAT, wearable activity tracker.

abandonment of WATs and other health technologies, limited research is available regarding factors contributing to long-term use. The current study quantitatively examined factors associated with the long-term WAT use using an online sample of older adults in the United States. Being a long-term WAT user was significantly associated with using more WAT functions, wearing WAT every day, being female, exercising more frequently, having higher education, not engaging in competition in step counts, and not having chronic conditions. Initial motivations, including regular monitoring and social exchange, receiving WAT as a gift, household income, age, and being married, were not predictive of older adults' long-term WAT usage.

Participants who reported using a greater number of WAT functions must have owned more sophisticated WATs that offer multiple functions. These participants might also have had the skills and self-efficacy to explore different features of WATs and customize the devices for their needs. This suggests that technology savviness promotes long-term engagement with WATs. Long-term users who have had the WATs for longer will have more time to try out different functions, while short-term users may have given up before they discovered their favorite or the most useful functions.

Wearing WATs every day is a strong predictor of long-term use, which is consistent with the habit formation literature. Habit is characterized by consistent, repetitive, automatic behavior in a stable context.[28] When users repeat the WAT usage in a consistent manner (e.g., wearing WAT every day), they are likely to form a habit that will result in automatic WAT use on a long-term basis. The role of habit in predicting the continued information system usage has been established in prior studies.[29,30] Evidence suggests that previous offline habits and the functionalities of the device itself help form WAT use habits.[20] Therefore, to design devices that encourage long-term use, it is important to build in features that promote the frequency of WAT use from the moment of its adoption.

Competition with family and friends through WATs decreased the odds of long-term use. While some prior research

Table 2. Logistic Regression: Factors Associated with Long-Term Use of Wearable Activity Trackers ($N = 214$)

	ODDS RATIO (95% CI)	*P*
Motivations for adoption		
Regular monitoring	1.84 (0.73–4.65)	0.20
Social exchange	0.71 (0.32–1.56)	0.40
Received it as a gift	2.29 (0.82–6.42)	0.11
Usage patterns		
Wearing WATs every day	5.26 (1.61–17.2)**	0.006
Number of functions used	1.27 (1.04–1.55)*	0.02
Engaging in competition	0.07 (0.02–0.21)***	0.000
Sociodemographic factors, health status, and activity levels		
Age	1.02 (0.96–1.09)	0.42
Frequency of exercise	2.18 (1.43–3.33)***	0.000
Having chronic condition(s)	0.31 (0.12–0.80)*	0.02
Female	4.30 (1.46–12.64)**	0.008
Being married	1.27 (0.34–4.77)	0.72
Household income	1.28 (0.92–1.79)	0.15
Education	2.02 (1.20–3.40)**	0.008
Log Likelihood	−60.04	

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

CI, confidence interval.

Note: McKelvey and Zavoina $R^2 = 0.69$, McFadden's Adj $R^2 = 0.37$.

suggests that social competition is fun[31] and may increase long-term engagement,[2] some prior qualitative findings suggest that competition is either demotivating[22,32] or serves as a double-edged sword and only works for certain individuals.[33] When designing a WAT and an associated app for older adults who are generally less active and may have chronic conditions, support groups focusing on cooperation and mutual encouragement instead of competition might be more effective to ensure long-term use within this population.[34]

A successful long-term WAT user is more likely to be an older female who does not suffer from any chronic illness, engages in exercising activities frequently, and has higher education, which is consistent with previous research on health technology adoption.[23–25,35–37] People with higher education, who have the basis to develop and master such skills, have an advantage in maintaining technology use over time, whereas individuals with lower socioeconomic status (SES) become more vulnerable to discontinuing WAT use.

Having chronic conditions is associated with decreased odds of long-term use of WAT. How to design WATs for older adults who have chronic conditions deserves further investigation, especially given that people with chronic conditions could potentially benefit the most from long-term WAT use. Moreover, the present study showed that respondents who exercise more are more likely to maintain WAT use. WAT use could be more satisfying to those who are active and can see immediate feedbacks. Yet, the question is how to engage older adults with lower levels of PA for long-term WAT use. With the expectation that WATs can support the health of high-risk individuals and those with chronic illnesses,[38] this finding suggests that much work is yet to be done by technology designers, researchers, and public health professionals before such devices become truly accessible to those who perhaps need them the most.

Initial motivations' nonsignificant effects on long-term usage suggested that participants' reasons for initiation may not be enough for sustaining long-term engagement. Motivations for adoption have transformed nonusers to users. To become a long-term user, factors such as age, income, and usage patterns start playing a larger role. The results of this study also showed that obtaining a WAT as a gift was not related to becoming a long-term user, which may suggest that gift recipients must personally identify with the importance of using the device consistently for their health before they become a long-term user.

LIMITATIONS

There are several limitations of this study. First, a predominantly white, relatively young older adult, healthy, and tech-savvy sample is not a typical sample of older adults in the United States. This limits the generalizability of the results. The use of such samples is inevitable when studying health technology use that is heavily reflective of the digital divide. The nature of this study automatically excluded older adults who did not adopt WATs, tending to be people of lower SES and lower technology ownership. Second, to clearly conceptualize short- versus long-term use, we did not include current WAT users who had not used WAT for more than 6 months. This may have prevented us from learning more about the usage behaviors of this group. Third, despite our best effort to follow the previous literature in categorizing short- and long-term users, there is no agreement in the literature regarding the definition of long-term engagement with WATs.[7,16,39] Thus, our choice of 6 months as the point of distinction between short- and long-term users may be perceived as

arbitrary and is worth further exploration. Fourth, self-reported survey responses are typically susceptible to social desirability and recall bias. Finally, the reliability coefficients of the two identified motivations for adoption are relatively low, which may have biased the significance testing results of motivations for adoption.

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