# The Use of Wearable Activity Trackers Among Older Adults: A Focus Group Study of Tracker Perceptions, Motivators, And Barriers in Different Stages of Behavior Change

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## Abstract

**Background:** Physical activity benefits older adults by protecting against morbidity and mortality. Wearable activity trackers (WATs) offer the opportunity to increase physical activity through continuous monitoring. We explore the nuances of WAT use and adoption among older adults using the transtheoretical model (TTM) of behavior change.

**Objective:** We investigate older adults' perceptions and uses of WATs in different stages of WAT adoption.

**Methods:** Data for the research come from 10 focus groups. The first set of focus groups was with participants who had never used WATs. These focus groups included a WAT trial. Other focus groups (without the trial) were conducted with short-term, long-term, and former WAT users.

**Results:** Older adults in different WAT use stages liked and wished for different WAT features, with long-term users being the most diverse and sophisticated users of WATs. Long-term users had developed a habit of WAT use while other participants needed to employ various encouragement strategies. Social support, with the focus on collaboration, was the primary motivator for long-term users, while short-term and former users focused on competition, and non-users engaged in vicarious WAT use experiences. Finally, long-term users were more likely to see benefits of WATs while other participants focused on obstacles related to WAT use.

**Conclusions:** WATs may be an effective technology to encourage physical activity among older adults. Yet, WATs alone are not likely to be successful in changing behavior. Tailored approaches based on the TTM stage of change as well as motivations, facilitators, and specific WAT characteristics that are important for older adults will ensure successful long-term use.

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# Original Manuscript

# The Use of Wearable Activity Trackers Among Older Adults: A Focus Group Study of Tracker Perceptions, Motivators, And Barriers in The Maintenance Stage of Behavior Change


## Abstract

**Background:** Wearable activity trackers (**WATs**) offer the opportunity to increase physical activity (**PA**) through continuous monitoring. Viewing tracker use as a beneficial health behavior, we explore the factors that facilitate and hinder long-term WAT use applying the transtheoretical model of behavior change (**TTM**), with the focus on the maintenance stage and relapse.

**Objective:** We investigate older adults' perceptions and uses of WATs at different points of WAT use: from non- and short-term use to long-term use and abandoned use to determine factors to maintain WAT use and prevent users from discontinuing tracker usage.

**Methods:** Data for the research come from 10 focus groups. Four focus groups included participants who had never used WATs (N=17). These focus groups included a WAT trial. The other six focus groups (without the WAT trial) were conducted with short-term (N=9), long-term (N=11), and former WAT users (N=11) (two focus groups per user type).

**Results:** The results revealed that older adults in different WAT use stages liked and wished for different WAT features, with long-term users (WAT users in the maintenance stage) being the most diverse and sophisticated users of WATs. Long-term users had developed a habit of WAT use while other participants made an effort to employ various encouragement strategies to ensure behavior maintenance. Social support through collaboration was the primary motivator for long-term users to maintain WAT use. Short-term and former users focused on competition, and non-users engaged in vicarious WAT use experiences. Former users, or those who relapsed by abandoning their trackers, indicated that WAT use was fueled by curiosity in quantifying daily PA rather than desire to increase PA. Long-term users saw a greater range of pros in WAT use while others focused on cons of this behavior.

**Conclusion:** The results suggest that WATs may be an effective technology to encourage PA among older adults, especially those who have never tried it. However, initial positive response to WAT use does not guarantee WAT use maintenance. Maintenance depends on recognizing long-term benefits of WAT use, social support, and internal motivation. Non-adoption and relapse may occur because of technology's limitations and gaining awareness of one's PA without changing PA level itself.


**Keywords:** older adults, wearable activity trackers, Transtheoretical Model, maintenance stage, physical activity

## Introduction

The focus of the present study is on exploring the nuances of maintaining the use of wearable activity trackers (**WATs**) and reasons to discontinue WAT use in the population of adults who are 65 years of age or older. Academic and industry research has shown that the use of WATs can increase physical activity (**PA**) through continuous monitoring of activity progress, motivational messages, social support, and many other empirically tested behavioral change techniques [1-4]. WAT facilitate PA, which is beneficial for older adults due to PA's protective power against diseases associated with older ages (e.g., heart rate)[5].

Despite the evident benefits of WATs for older generations, digital care today is more available to younger populations, leaving older adults on the periphery of the industry[6]. As little as 7% of older adults owned an activity tracker in 2014[7]. Although many adults are now aware of this technology with its increased popularity, this population still shows slow rates of adoption that depends on many factors, including WAT trial and price[8,9]. Only a few studies have been done to understand how and why older adults maintain the use of WATs and why they choose not to use or stop using this wearable technology [10-12]. Even if individuals decide to use WATs or are given a WAT at no cost, it does not guarantee that they will continue using them on a long-term basis. One in three activity tracker users of all adult ages stop using the device within six months after purchase[7,13]. The length of use correlates with age, where adults who are 70 years old or older quit using WATs in only two weeks[14].

Little comprehensive evidence exists with regard to long-term use of activity trackers by older adults [10,11], motivations for long-term use[2,3], and differences between non-use, short- and long-term use. To study how older adults maintain the use of WATs and why their motivation to maintain WAT use grows stronger or fades over time, we applied the transtheoretical model of behavior change (**TTM**) with the focus on the maintenance of desirable health behavior and relapse (discontinued WAT use). In the literature review below, we, first, introduce the theoretical framework of TTM, then discuss PA and WAT use in older adults, and finish by addressing prior research on the maintenance of PA and WAT use behaviors.

## Transtheoretical Model of Behavior Change

The present project explores motivations and barriers associated with the sustained use of WATs through the lens of the TTM. The TTM employs the stages of change to integrate processes and components of change across major theories of intervention[15-17]. A key element to the TTM is the stage of change as the construct is the temporal dimension to the framework. The TTM proposes that change is a process that unfolds over time and progresses through a series of six stages. In the pre-contemplation stage, people do not plan to change their behavior in the near term because they are either uninformed or under-informed about the consequences of their behavior. For example, older adults might not be aware of the existence of WATs or realize what health benefits WAT use entails. The costs and benefits of change potentially produce uncertainty and some people remain in contemplation for extended periods of time. For instance, WAT use could be perceived as beneficial but the price and lack of technology skills could stop older adults from adopting it. People begin to take significant steps toward the behavior change in the preparation stage. There is a plan of action and the critical stage for recruitment into action-oriented programs. In the action stage, an individual makes specific evident lifestyle modifications, such as wearing WAT every day and changing daily routines to increase trackable activities.

The continuation of the specific behavior and lack of relapse is the maintenance stage. Relapse, however, is a common occurrence in the maintenance stage where individuals abandon new behaviors and/or return to old ones (former WAT users in this study). Older adults may successfully maintain the use of WAT for a period of time; yet, some may stop at some point. What makes older adults continue to use the technology and what contributes to its abandonment is in the focus of this article. During the maintenance stage, individuals have made specific and apparent changes to their lifestyles, and their continuous efforts to prevent against relapse no longer require frequent applications of the change processes as one would during the action stage. Individuals in the maintenance stage (long-term WAT users in this

study) are less likely to be tempted to revert to previous behaviors, and they have increased confidence and self-efficacy in keeping up with the changes. When making a behavior-related decision, individuals in the maintenance stage are more likely to consider and be influenced by pros rather than the cons associated with the behavior[18]. The estimated duration of the maintenance stage is about 6 months to 5 years before the termination stage[17].

## Wearable Activity Trackers Increase Physical Activity

WATs refer to sensor-based wearable devices that automatically track and monitor various indicators of PA, such as steps taken, stairs climbed, duration and quality of sleep, pulse or heart rate, calories consumed or burned, and even mood [28]. WATs synchronize these data with users' personal accounts, ensuring easy access from any device. Although specific features available depend on WAT brands and models, older adults typically use WATs to monitor distance covered, steps taken, calories burned, sleep time, and heart rate[11], making WATs a convenient tool for this age group that provides feedback about PA amount and intensity.

PA in older adults reduces the risk of chronic diseases such as cardiovascular disease, stroke, obesity, and hypertension, improves cognitive and mental health, lowers the chance of falls, and helps maintain a longer independent life[19-21]. The minimum recommended level for older adults is 150 minutes of moderate-to-vigorous PA per week[22]. Despite this recommendation, older adults constitute the most sedentary age group[23-25]. Almost 84% of older adults aged 65 and older do not meet the aerobic and muscle-strengthening PA requirements[26], which makes WAT a particularly relevant technology for this age group. In particular, PA recommendations for older adults focus on moderate-intensity aerobic and muscle-strengthening activities such as walking, jogging, bicycle riding, yard work, and gardening [21,27]. Some of these activities are tracked by wearable technology.

WATs have the advantage of boosting PA through the integration of empirically tested behavioral change techniques such as goal setting, self-monitoring, social support, social comparison, feedback, and rewards[3,4], in contrast to antecedent technologies, such as pedometers. Self-monitoring and goal-setting have been especially effective in promoting self-efficacy and PA in interventions [29]. It has been found that even though wearing a new piece of health technology is a novel activity for older adults, they appreciate WATs' contribution to self-awareness and goal-setting. WATs provide older adults with relatively unbiased data about basic activities. Additionally, older adults view WATs as helpful motivators in achieving walking goals and competing with themselves[8]. Another important advantage of WAT use in the "65+" population is social connection. For a population that is characterized by social isolation and loneliness [30], technology that addresses social connectedness needs are perceived as helpful in overcoming barriers to increase PA[31].

Adults in general and, specifically, older adults who started using wearables have been shown to increase daily activity levels [1,10]. A seven-month study of 18 participants (aged 36 to 73) who were given a Fitbit One WAT [32] found that sixteen participants continued to use it after seven months. The benefits of use included weight loss, social connection, and increased activity awareness. Participants aged 60 and older who were given a Nike Fuel WAT reduced waist circumference and increased step count during another 12-week study [2]. African-American and Hispanic older female participants, who tested a Fitbit Zip WAT in a 7-week study, increased their PA level, lost weight, and lowered blood pressure levels [33]. WATs have been found to be more effective than their "predecessors", where sedentary female older adults

who used Fitbit WATs significantly increased their PA compared with those who used pedometers [1]. A Fitbit One WAT that delivered prompts via short message service has also been found effective in increasing moderate to vigorous PA among overweight and obese adults [34].

Although WATs can be helpful in increasing PA, this technology is not ideal. For example, in a study with eight adults who were 75 or older, three participants experienced technical problems with the WATs, preventing them from gathering any activity feedback [35]. Participants reported that they could only get the WAT to work 78% of the time.

## WAT Use Maintenance Among Older Adults

To date, there is a dearth of research employing the TTM to examine the efficacy of WAT-based interventions to maintain PA level, along with WAT use, among older adults [39,40]. Research based on a general population sample has shown that nearly three fourths of participants discontinued using WATs after 100 days from the initiation date, with most dropouts explained by technical failures and loss of WATs. In that study, four participants older than 65 were among those who stopped using WATs within the first 100 days. Age, along with positive user experience, perceived WAT effects, and playing individual sports with family, positively predicted WAT use duration among those who continued using this technology after 100 days[41]. Another study with an older sample of patients recovering from a myocardial infarction (average age = 56) found that WAT use was successfully maintained for over one year. Generally, participants used WATs several days a week but not on all days. WAT use on all days was common only for the initiation period and only for a few patients [42].

## Study Objective and Research Questions

While multiple TTM studies have investigated the adoption of health-related behaviors, fewer have examined behavior maintenance and its abandonment after a period of long use[16]. In the present study, we focus on *WAT use* (not PA per se) as a beneficial health behavior and explore factors that contribute to the successful maintenance of this behavior and, on the other hand, failure to maintain it among older adults. We conducted focus groups with four types of WAT users who were 65 or older: long-term, short-term, former users, and non-users. Insights from long-term users helped us understand strategies that they employed to maintain WAT use and WAT features that encouraged such WAT use sustainability. Talking with short-term users allowed us to compare WAT use strategies and WAT perceptions at the initial and the maintenance stages of WAT use. Experiences of non-users and former WAT users were analyzed to examine how central WATs were to encouraging PA in older adults and what were the reasons for not using or abandoning this technology.

***RQ1a:*** *What features and functions do adults who are 65 and older consider useful and would like to have on their WATs?*

***RQ1b:*** *What are similarities and dissimilarities in perceptions of tracker features and functions between adults who are 65 and older at the maintenance stage of WAT use (current long-term users), those who stopped using WATs (former users), those who were only at the initial stages of WAT use (short-term users and non-users after WAT trial), and those who are not familiar with the technology (non-users before WAT trial)?*

***RQ2a:*** *How do perceived benefits and motivators associated with older age drive WAT use in adults who are 65 and older?*

***RQ2b:*** *How do WAT long-term, short-term, former users, and non-users who are 65 and older compare in terms of perceived benefits and motivators?*

***RQ3a:*** *What barriers do adults who are 65 and older experience during WAT use?*

***RQ3b:*** *What are similarities and differences in perceptions of WAT use barriers among WAT long-term, short-term, former users, and non-users who are 65 and older?*

# Methods

## Recruitment, Participants, and Procedures

Ten focus groups with adults aged 65 and older were conducted. Four WAT-trial focus groups were conducted with WAT non-users, where each participant attended two meetings. After the initial focus group, non-users were offered a WAT to use for several weeks and then attended a follow-up focus group meeting. Six additional focus groups that did not involve a WAT trial were conducted with short- and long-term WAT users and former WAT users (two focus groups were held per user type). Each focus group lasted approximately 2 hours. Each participant received $20 for participation.

Up to 10 people were invited to each focus group, with the use of convenience sampling strategies[49-51]. Participants were recruited through local senior centers; university's listservs; and an online recruitment system at a large Midwestern university. The online recruitment system (SONA) provides access to over 7,000 community-dwelling individuals who are interested in research participation (4% are 61 years of age or older). Flyers were distributed at local churches and senior centers, posted on Facebook networking groups and published in a local newspaper. General participant selection criterion was that participants had to be 65 years of age or older. Focus group locations included a local community center, hospital building, senior center, and university campus.

Older adults who were interested in our study contacted the research team through phone or email. A research team member provided a brief overview of the study and asked each participant screening questions regarding use of WATs (e.g., length of use) and date/time preferences for the focus group. Potential participants were invited to focus groups based on WAT usage. Individuals who had never used a WAT were invited to the WAT non-user group. Short-term users were the current users of WAT who had been using it for less than six months. Long-term users were the current users who had been using the technology for six months or longer. Former users were individuals who had used a WAT in the past but stopped.

The focus groups were conducted by the members of the research team who developed and refined the focus group protocol. The first focus groups were conducted by researchers with substantial experience in conducting focus groups and in-depth interviews. Those who were new to the procedure observed the focus groups first and then led their own under the supervision of more experienced colleagues. A structured guide was used for each focus group.

All materials and study procedures were approved by the Institutional Review Board at the university where the study was conducted. Participants in each focus group were given time to read the consent form, which provided the option of not participating and withdrawing at any time. Participants were given an opportunity to not answer any of the questions asked. Data confidentiality was guaranteed. None of the participants refused to answer questions or stopped participation. Participants consented to audio and video recording by signing the consent form and a video release form.

After participants signed the consent form, focus group procedure began. Participants filled out a short survey to collect information about demographics, medical conditions or disabilities, baseline activity levels, and health status. Then they were provided instructions about focus-group procedure (e.g., there were no right and wrong answers, positive and negative opinions were equally important). The conversation started with an icebreaker question about favorite personal technology. After the tone of the focus group was set, they shared their associations with term "wearable activity tracker," described their experiences using it or observing others using it, and provided ideas about an ideal WAT. Then the conversation moved to an in-depth discussion of reasons to start using the technology, or the lack of thereof, and motivations for continued WAT use, Benefits and barriers of WAT use and its influence on users' lives were discussed, as well. Former users also discussed reasons for abandoning the technology. At the end of each focus group, participants shared their opinions about the role of PA and wearable technology in maintaining one's good health and were provided an opportunity to add anything else the discussion. After the focus group was over, participants received compensation. Non-users in the initial focus groups also received a tracker and instructions for its use.

## Focus groups with WAT non-users

Four focus groups (two initial and two follow-up focus groups) were conducted with older adults who had never used a WAT. The first set of focus groups ran in February ($N1$ = 10) and the second set ran in May ($N2$ = 7) to account for seasonal effects on PA [34]. At the end of the first focus group, participants were given an activity tracker, Garmin Vivofit 2, to use for two weeks in February and four weeks in May and then returned for a follow-up focus group to discuss benefits and barriers to WAT use and acceptability of the technology. May participants kept their WATs at the end of the follow-up focus group as part of the participation incentive. The two trials (February and May) differed because the suggestions from February focus group participants were incorporated into the May trial procedure. The suggestions included 1) making the trial period longer, 2) clarifying WAT use instructions and creating instructional and motivational videos, and 3) incentivizing participants by giving away WAT as a gift (see Results for more detail). Participants in the February group received a demonstration of how to put on the WAT, a brief overview of the features, and a written instruction book. Participants in the May group received everything from the February group plus instructional and motivational videos. The instructional videos demonstrated how to use the WAT (e.g., how to put the tracker on and off, taking the tracker out of the wrist band, how to use the tracker). Motivational videos were recorded with WAT long-term users (participants from the first long-term use focus group) who shared positive WAT use experiences and tips to maintain WAT use.

Garmin Vivofit 2 tracker is a wrist wearable device that records steps taken, calories burned, and distance traveled. The Vivofit 2 has a yearlong battery life and is water resistant up to 50 meters deep. Because the Vivofit 2 does not need to be charged frequently, participants were expected to be less likely to forget the trackers on the chargers or stop wearing them. We also

chose the waterproof option due to prior evidence that water-related activities (e.g., water aerobics) are especially popular among older adults [34]. The Vivofit 2 has a large display screen to ensure ease of reading for older adults.

### Focus groups with WAT short-term users

Two focus groups (*N3* = 2, *N4* = 7) were conducted with older adults who had started using WATs within six months before the focus groups (on average, they had used their WATs less than 3 months). Four of the short-term participants in the second focus group were the same participants who took part in the non-users trial focus group in May. These participants kept their WATs and continued using them, which qualified them to participate in the short-term use focus groups. Garmin was the most used WAT in this group (*n* = 5), followed by Fitbit (n = 4).

### Focus groups with WAT long-term users

Two focus groups (*N5* = 7, *N6* = 4) were conducted with older adults who had been using a tracker for over six months at the time of focus groups. Participants had experience using either Fitbit (*n* = 9) or Garmin (*n* = 2). One participant had used Apple Watch in addition to her Fitbit. On average, they had used WATs longer than 12 months.

### Focus groups with WAT former users

Older adults who had previously used a WAT for any period of time but stopped using them before the focus groups occurred were invited to participate in one of two focus groups (*N7* = 9, *N8* = 2). Participants predominantly had used Fitbit (*n* = 7), but they also mentioned Garmin, Jawbone, Misfit, Nike, Gear Fit, manual pedometers, and special medical technology provided by a local hospital (e.g., health management app). On average, their WAT use lasted for nearly 10 months.

## Data Coding and Analysis

Focus group conversations were audio recorded. Audio files were de-identified and transcribed using an online service. Data were inductively analyzed; exploratory thematic analysis was performed to indicate common nodes. Five coders iteratively analyzed the transcripts using NVivo, software for qualitative data analysis. First, all coders analyzed two randomly selected transcripts. After the general agreement over the codes was established based on an in-depth discussion of each code[52], two coders analyzed four additional transcripts and another two coders worked with the remaining four transcripts. The fifth coder checked the quality of coding to ensure consistency. The coders met regularly until they finished coding all transcripts to discuss their interpretations of the existing codes, introduce new codes, reach mutual agreement on them, and create new code labels [52]. Some codes were aggregated into code categories during these meetings. When a disagreement was identified, it was discussed and then the coders recoded the transcripts following the adjusted coding procedure. Thus the coding rubric was being refined throughout the coding process because each new set of focus groups introduced new ideas and meanings. Inter-coder agreement was ensured by extensive discussions of each new code[52]. At the end of the coding procedure, NVivo results from the coders of the same transcripts were compared to confirm coders' agreement on the most prominent codes. Nodes were aggregated in more inclusive categories, which were used to derive themes. Table 1 presents the map of the most prominent codes and code categories by focus group type. These codes were used to conduct thematic analysis and further understand differences among the four types of users. Quotations most representative of each theme were

selected per agreement of all researchers from a larger pool of quotes that corresponded to each node and node category. Research team members reviewed multiple quotes and made suggestions about which ones to include in the article.

# Results

## Sample Description: Demographics and Beyond

Table 2 displays information about participants' age, gender, race/ethnicity, and occupation by focus group type. Most of the focus group participants were female, especially in long-term and former users groups. Participants in these groups were also younger. The majority of participants were white. Two out of three short- and long-term users had completed graduate degrees, while about a third of non-users only had graduated high school and had some college education.

Information about chronic conditions, PA types and frequency, and WAT use length by focus group type is provided in Table 3. More short-term and former WAT users than other participants reported having a chronic condition. Former users showed the greater diversity of PA, while non-users were mostly focused on walking. Walking and gardening were the most popular activities for long- and short-term users. Non-users exhibited the lowest level of PA frequency.

As part of focus group discussion, participants talked about the meaning of health and the role of PA and WATs in such perceptions. There were little differences across groups as most participants associated being healthy with freedom and independence, ability to move, being in good mental health, having high quality life, and holding positive attitudes (Table 1).

Many participants occasionally referred to themselves as being "laggards" and "luddites," i.e., not being technologically savvy. Short-term users described themselves as "having health issues" and "being active." Long-term users also mentioned having health issues, but were more likely to describe themselves as being technologically savvy and early technology adopters. Talking about their favorite technology during the icebreaker, participants mostly referred to information and communication devices, such as desktop and laptop computers, mobile phones, and tablet computers. Technology access by focus group type is shown in Table 4. Notably, the majority of long-term WAT users did not have access to landline phones. Most participants associated WATs with pedometers and other health management technology.

## Ideal Tracker: Prettier, Bigger, and More Comfortable

Research questions 1a and 2b asked about the perceptions of tracker features and functions. Non-users before the WAT trial did not have any experience with the technology and many did not know what it was, so they could not clearly identify what features they favored. The only experience some non-users had previously had with wearables was vicarious where they generated their knowledge through observing others. In their descriptions of an ideal tracker, non-users expressed great interest in a possibility to *monitor diverse activities*, such as biking, water aerobics, golf, and others. Non-user participants also suggested that an ideal WAT should count *calories burned*, monitor *heart rate*, *look good*, and be *user friendly*.

After trying WATs, non-users found four features and functions to be useful. It could be used as

a *watch* to show date and time; it had a *comfortable band;* it tracked *sleep*; and it was *waterproof*. Interestingly, step count feature was not the favorite feature among the non-users as most perceived step quantification to be inaccurate.

After the WAT trial, non-users' preferences for an ideal WAT notably changed. While they continued to suggest that WATs should be aesthetically appealing and not "ugly", they focused on WAT band comfort, which, according to many participants, Garmin VivoFit 2 lacked. Non-users described the band as "plastic" (i.e., cheap, of bad quality), "clunky," "annoying," "rigid", and "uncomfortable."

> **Female Participant, non-user:** "It's very rigid. The design is poor. It collects water underneath. I end up having a really loose bracelet. Which could have some effect on accuracy. I don't know. I found it totally uncomfortable. It's really ugly."

Another characteristic of an ideal tracker that was mentioned by non-users after the VivoFit 2 trial was related to design features for *better vision*. Those referred to multiple aspects of WAT display that made reading easier, from the size of symbols to the direction of symbol placement on the screen (horizontal vs. vertical) and light.

Looking "nice," "cool," "fashionable," as well as looking like something else (e.g., "watch," "bracelet," or "necklace") and having a comfortable band were equally important for participants in all four types of focus groups. Short-term and former WAT users identified simple usage patterns by focusing on the importance of step count. They also wished that WATs were more "user friendly" for older adults when they discussed device maintenance.

Short-term users expressed an appreciation of heart rate monitoring feature and wished to have features for better vision and a *stopwatch* function on their ideal WATs. Former users liked the sleep-tracking feature and wanted a WAT that measures *blood pressure* and provides *accurate information*.

Long-term WAT users, who were in the maintenance stage, showed a much more diverse usage of WATs and had a more elaborate "wish list." In addition to features popular in other focus groups, long-term users identified *motivational messages and reminders*, *pace tracking*, and *calories burned* as being important.

> **Female Participant, long-term user:** "I use mine as a, as a watch, um, when I wear it. I use it for distance, I use it for time, and I use it for my pace and calories expended."

Time feature, in addition to PA tracking, was crucial to long-term users. They also wanted WATs to be waterproof, have longer *battery life*, track *physical progress* in real time, automatically count *calories consumed*, and measure heart rate.

## Maintenance: Trial, Opportunity, Togetherness, and Internal Motivation

Research questions 2a and 2b asked about participants' perceptions of WAT use benefits and motivational strategies that they used, would use, or had used to sustain tracker usage over time. The overarching idea expressed by non-users before the WAT trial was that trackers *would not motivate* them to increase PA. Some non-users suggested they would be interested in *increasing awareness* of their daily activity as it could encourage them to move more. *Goal*

*setting*, or knowing exactly what outcome to strive for, could also strengthen the WAT use motivation. Several non-user participants named *long-term benefits*, such as staying away from medications, feeling better, losing weight, and improving physical indicators of health (heart rate, blood pressure), as motivations that could drive WAT use.

After trying Garmin VivoFit 2, the "WAT does not motivate" theme became less pronounced. Participants agreed that WAT use motivated them to walk more, driven by the WAT quantifying activity by counting steps and continuously making users "more conscious of extra walking" (Female participant, non-user).

> **Male Participant, non-user:** "I did find myself looking all the time, how many steps I had, and did try to. In a couple days, I had like 2,000 steps and felt guilty as all get out. I really enjoyed it. I didn't think I would, I thought maybe for a week or two, the novelty you know. In fact, I'm monitoring it as I came upstairs today, so I'm really enjoying it."

The overwhelming tactic that the non-users used was to slightly *modify daily activities* to take more steps. Those included taking stairs instead of elevators, parking far away from destination buildings, or walking to an area instead of driving.

Short-term and former users talked about the same tactics that non-users did, with an addition of two new "tricks": using a "red-line" WAT alert of inactivity and shopping.

Short-term and former users were also motivated by the *presence of others*: either participants competed with their friends and family members in numbers of steps taken, were supported by them (e.g., being given a tracker as a gift), or simply observed them using WATs.

> **Female Participant, former user:** "I would say one of the things that I did, my kids had gotten some wearables, and so we had a little contest. That encouraged me, instead of having the red line or something like that. It was like, 'Oh, so how many did you do today?' It was a non-threatening way of getting everybody to see what they did, so, 'You only did so many steps today? What's going on with you?' "

The presence of others was the top motivator for long-term users. Although competition was an important motivator, the importance of "togetherness" and cooperation, i.e., doing something enjoyable together to achieve individual fitness goals, was more prevalent in conversations with long-term users.

> **Female Participant, long-term user:** "When we lived in Houston, and we both worked and carried pagers and cell phones or whatever, Friday night was date night and we started date night with a run together. And, cooled down, and then went out to dinner. So, it's part of our marriage in a way, and it was part of our dating relationship and that's when I think about, it's just like brushing your teeth every morning."

Achieving goals was very satisfactory to long-term users who derived gratifications from using WATs that confirmed completion of daily activity tasks and gave "rewards."

> **Female Participant, long-term user:** "It's just amazing when it tells me I've gotten my 10,000 steps in, I've gotten my ten stairs, I've burned my 2,000+ calories, whatever, and I get this little green flashy thing on my phone, it's stupid I get it, but I look for that at night.

"Oh did I get my flashy thing?" Ya know? It's, it's motivating."

Long-term users were more likely than participants in other focus groups to see long-term benefits of regular PA and, consequently, WAT use, such as physical and emotional health (e.g., stress reducer), reduced pain, independence and mobility, and long life.

> **Female Participant, long-term user:** "When you start seeing your classmates in the obituaries, I think that..."
> **Female Participant, long-term user:** "It's an eye-opener, isn't it?"
> **Female Participant, long-term user:** "Or you see them and you think, 'Boy, do they look old!' [laughs] you know? 'I don't want to be that person…' "

Long-term users, compared with other participants, perceived external factors, such as change of weather, as *opportunities*. Seasons, especially summer, facilitated physical movement. One participant found an opportunity to be physically active in winter by shoveling snow (male participant, long-term user). Long-term WAT users, however, expressed that external factors did not fully determine motivation. "Forcing" oneself, being consistently active day to day, allowing bad days but "reimbursing" for them later was indicative of *internal motivation* playing the most important role in maintaining PA. Technology came in second, only as a facilitator.

> **Female Participant, long-term user:** "It's something that clicks in your mind. You have to make that commitment, and once you do, the technology is very motivating. But, until you take the step of getting it and tuning into it, it isn't going to work."

## What's Stopping 'em: Data Inaccuracy and Lack of Adequate Instructions

Research questions 3a and 3b asked about perceived barriers to WAT use. Participants in the former and shot-term user focus groups appeared to like their routines and established exercise schedule to which WAT did not add. To them, psychical activity came before WAT use. It was not that participants were not motivated to be active (they actually were), but WAT use did not seem to be the driver of that motivation.

> **Female Participant, short-term user:** "[…] I've done 9,000 steps and it's 8:30 at night and it's my time to sit and quilt. I'm not going to do anymore. [laughs] I figured out I've done plenty."

WAT non-users mostly generated questions and speculations about how trackers worked. "Are they waterproof?" "Does it monitor your sleep?" "Do we have to keep it on our wrist?" "Is it physically moving or is it your wrist that tracks us?" "Does it tell time?" "Is it counting calories you're using?" With the lack of knowledge came skepticism as non-users questioned the ways WATs worked. Inaccuracy in counting steps raised most of the concerns. Participants explained that physical activities were very diverse and had different levels of intensity that no technology could grasp.

After the WAT trial was over, non-users continued to ask questions about how WATs worked. Their skepticism toward and disappointment with the technology increased because they found that WATs had given inaccurate information. It also had limitations in terms of features offered. Participants compared actual step recordings with their perceived activity and found

obvious inconsistencies.

> **Female Participant, non-user:** "I thought they were highly inaccurate. I clocked 1,350 steps just driving out to eat in Rapids one day."

After the WAT trial, non-users also suggested to improve WAT use *instructions* tailored to the population of older adults. They expressed the need to be better educated about various WAT features and functions, as well as synchronization with other devices, and suggested using step-by-step detailed instructions and in-group learning environment. In the first non-user set of focus groups held in February, participants suggested that video instructions (similar to YouTube videos) would work well to guide and motivate older adults in WAT use. Non-user participants in May groups, thus, were provided with such videos (see Method). However, most May non-user participants did not watch the videos, and those who watched them were not motivated more than they normally would be. Some participants experienced a classic case of the third-person effect [53]; they were sure that others "but not me" would be motivated by the videos.

Other reasons for non-adoption included high price, physical limitations that older adults face as well as inactive lifestyle, little interest and curiosity in trying WATs, band discomfort, and technology use difficulties. Technology-related barriers were discussed more extensively after the non-users tried WATs, especially with regard to smartphone ownership and synchronizing WATs with it.

Short-term and former users added that defects in WATs could or did make them stop using the WAT. One short-term user briefly discussed the issue of keeping personal data private when information from WAT is synchronized with a smartphone or computer and shared on social networks.

Former users indicated that long-term use of WATs was not necessary as one gets an impression of numbers related to certain activities. Many former WAT users were found to maintain the same daily routines, so they quickly learned how many steps, calories, and miles daily activities were associated. After that, using WAT was not a priority for them.

> **Female Participant, former user:** "I know that I get about 13,000 steps. I don't use it every day. I started wearing it again when I said I would sign up for it just to make sure that I was still doing what I thought I was doing because I walk in the morning before I go to work, and then do my activities."

A few former users also indicated that having a short battery life and losing the WAT were the reasons why they stopped using WATs.

Conversations with non-, short-term, and former users centered on barriers to adopt or continue using WAT, but this theme was less pronounced in long-term users who predominantly discussed WAT features and motivations to use. No unique additional barriers were discovered in focus groups with long-term users.

## Principal Results

### From the basics to sophistication

The results indicated that focus group participants, who were 65 and older, favored and expected their WATs to have a wider variety of features than what had been shown in previous research within this population[8, 14]. Participants with different levels of WAT use experience liked and wished to use different WAT features. Long-term users who were in the maintenance stage of WAT use indicated a more diverse and sophisticated usage of WATs. This could be explained by the length and richness of experience with WATs as well as the higher level of technological savviness mentioned by the long-term users. Non-users expressed disappointment with the technology as it did not meet their expectations regarding accurate step count and did not track various activities automatically. Health-related monitoring, such as weight watching, hear rate, and blood pressure were not the most popular features despite many participants reported having chronic conditions.

### From effort to effortlessness

Non-users and short-term users had to "trick" themselves into using WATs to counter-condition inactivity by slight modifications in daily routines. Long-term users were more habitual, automatic, and effortless in their WAT use. Long-term users emphasized the importance of internal motivation ("Just do it") where WATs were serving as secondary facilitators and expressed the enthusiasm about modifying the environment to "keep going."

### Maintenance through internal motivation

It is recommended to focus on the importance of intrinsic over extrinsic motivation to WAT use maintenance in future studies. The distinction between the two types of motivation is made within the framework of self-determination theory (**SDT**). SDT studies have consistently demonstrated that intrinsic motivations are predictors of long-term PA adherence and weight loss [56] [57]. SDT posits that motivation is driven by individuals striving to satisfy three essential needs: autonomy (independence in the world of external constraints), competence (self-efficacy), and social relatedness [58-60]. Intrinsic motivation refers to engaging in an activity out of one's authentic interest in it, which brings inherent satisfaction and feelings of enjoyment, accomplishment, and excitement [58,61]. For example, the long-term users in the present study not only emphasized the "Just Do It" aspect of sustained WAT use but also referred to positive emotional rewards they would get after completing their goals. Extrinsic motivation refers to engaging in activities that provide rewards from the outside. Extrinsic motivation with a greater degree of autonomy (e.g., increased socialization via WAT network) leads to a higher likelihood of behavior maintenance than external motivation with low autonomy levels (e.g., WAT use due to a doctor's prescription) that is only effective in the short run [58, 62-66]. The results of the present study suggest that long-term use of WATs depends mostly on intrinsic motivation and extrinsic motivation at greater level of autonomy, suggesting that this behavior can be successfully maintained over time. Satisfaction of the social relatedness need through WAT use is another powerful driver of maintenance.

### Observe-compete-collaborate

Social support was not a pronounced motivation for non-users who often observed others using WATs, and it was only secondary for short-term and former users who emphasized the importance of competition with others. Long-term users indicated social support to be the main motivational factor, with the focus on building relationships around daily activity

routines. Long-term users were better prepared to modify social environment around them to maintain active lifestyle, receive positive feedback, and seek accountability from others.

### Awareness before health benefits

Short-term, long-term and former participants exhibited high levels of PA, which could have contributed to curiosity about activity tracking but not to the understanding of its health management value. Non-users were unaware of WAT potential in helping to meet PA goals. Consciousness raising occurred among some WAT non-users as they realized that WAT use could benefit them in terms feeling better, losing weight, and lowering blood pressure. Non-users reported lower PA frequency and said WAT use helped them increase PA levels. This result suggests that WAT use could be more useful for those older adults who are not physically active and seek to change that. Our short-term and former users who showed high levels of PA indicated greater skepticism and disappointment with the technology. WATs provided them with information about PA but it did not motivate to make already active users be more active. It could be that because WATs did not drastically change PA levels in the group of former users, they failed to maintain its use.

### Achieving a pros-and-cons balance

Long-term users were more engaged in the discussion of WAT features and motivations, while participants in other groups focused on problems with WAT related to the lack of WAT knowledge and WAT use skills as well as WAT measures inaccuracy and defects. Long-term users also saw many more benefits of WAT use than their counterparts from other focus groups. This result is in line with the proposition of the TTM that the maintenance stage of behavior change is associated with seeing a greater number of benefits than costs [18]. Former users not only reported the same high level of PA as short-term and long-term users but also exhibited a greater diversity of physical activates, which indicated that WAT was not the primary motivator.

## Discussion

### Comparison with Prior Work

The present study contributes to the existing knowledge about wearable technology use in four meaningful ways. First, we analyzed the experiences of older adults at different levels of WAT use with a special focus on the maintenance stage of behavior change and relapse (i.e., discontinuing WAT use) [16]. Previous studies have explored activity tracker use mostly at the initial stages of use [2, 8, 10, 54] and have not systematically evaluated the spectrum of features used, liked, and wanted by adults aged 65 and older. Additionally, little research has been previously done on WAT use relapse in older adults, and our study filled that gap.

Second, we outlined several new WAT features and characteristics that adults in the “65+” age group would want to benefit from on a long-term basis. One of the significant findings of the present study was that our participants valued WAT comfort and aesthetics more than the basic features of step and calorie count, sleep and heart rate tracking, and water resistance that were found important for older adults in prior research [8,11]. The suggestion of making WAT accommodate the older target groups in terms of features for better vision came after. One possible explanation of these results could be that older adults felt underappreciated by the current consumer technology developers that often target younger populations. Thus, they

required devices to meet basic consumer needs in comfort and pleasant appearance to break the association with “bulky” and “ugly” devices “for older adults.” Another possibility is that our sample is skewed to be more highly educated than the average older adults; thus, their expectations may vary in terms of WAT characteristics. Further research with more diverse samples of older adults might yield different findings.

Third, the present study indicated that health benefits provided to adults who are 65 and older by WAT use were not greatly important to them. Participants in all focus groups put awareness of PA and curiosity as the primary reasons to start and continue WAT use. In general, the motivators to continuously use the tracker mirrored those mentioned in previous literature: PA awareness, goal setting, positive reinforcement, and social connection [1-4, 8, 10, 29-34, 37-38]. Participants in our study, like participants in other studies [43], saw the benefits of PA awareness via self-monitoring and goal-setting. Our findings regarding social support indicated that social support is not only one of the most important and consistent predictors of PA adherence [45-48] but also a crucial factor to maintain WAT use. Furthermore, we found that non-users expected WATs to track diverse activities and were disappointed that the technology did not do it. This is echoed by the findings of another study advocating for a more tailored approach to tracking activities salient to older adults [44].

Fourth, the present study added to the list of the known barriers to WAT technology adoption and continued use and explained why relapse in WAT use happens. In addition to technology defects, lack of technology use skills, physical and psychological limitations, and financial restrictions [35, 36], our participants added distrust in WAT’s capability of accurate data tracking. The questions that participants posed about WAT functions, speculations about how this technology works, and skepticism about it indicated a need for future studies of older adults’ technology literacy [55]. Former users were motivated by knowing the numbers behind their daily physical routines but they were not eager to use WATs to modify or increase these daily physical activities. This was the primary explanation for WAT use relapse that.

## Study limitations and suggestions for future research

Though our study was extensive in the type of WAT users included, the sample was more educated, slightly younger, and less ethnically and socioeconomically diverse than older adults in general. For example, 23% of older adults in the “65+” age group in the United States were members of racial or ethnic minority populations in 2016 [67], which is higher than the percent of our sample participants who were not white (less than 15%). In terms of educational attainment, approximately 86% of older adults completed high school and about 30% completed a bachelor's degree or higher in 2017 [67]. Our sample was highly educated, with over 40% of participants holding a graduate degree. Furthermore, 44 of the 48 participants (92%) had access to a mobile phone, which is higher than the national average of 78% [51]; 39 out of 48 (81%) had access to a tablet computer, which is also higher than the national rate for older adults (32%) [51]; and 36 out of 47 (75%) reported having access to an Internet-enabled laptop computer, which is also higher than the national average of 55% [51]. Higher levels of education, income, technology access, younger age, and greater homogeneity in terms of race/ethnicity could influence the level of physical activity in older adults and, as a result, emphasize certain perceptions of WATs detected in this study. For example, only 6% of our participants did not engage in PA and another 6% engaged in it only once a week. This is much lower than the national average where 84% of adults 65 and older live sedentary lifestyles [23-25]. Perhaps demographic and PA characteristics of our sample led to skeptical

perceptions of WATs, emphasis on internal motivation to maintain WAT use and PA, as well as viewing WAT as the tool to increase the awareness of PA rather than PA itself. That is why, possibly, WAT use was found to be most beneficial to non-users who were less active and had lower technology access. Future studies should focus on sedentary older populations to explore WAT maintenance and relapse. Studies with more diverse samples of older adults might reveal other facilitators and barriers to using WATs. In particular, Additionally, the study solely focused on adults who are 65 and older and did not collect empirical data from younger WAT users. This shortcoming should be addressed in future scholarship.

We had difficulty recruiting short-term WAT users. This leads us to question WAT uptake among older adults, at least in the Midwest state where this study took place. To our surprise, it was easier to find participants who had been using WATs for over six months than those who had just started using this technology. Additionally, we used only one type of WAT with our non-user participants. The limitations of Garmin Vivofit 2 could have had an effect on non-users' evaluations of WATs in general.

Finally, including participants with specific types of chronic diseases could yield specific WAT use facilitators and barriers for these groups that might influence future studies. We were not able to focus on specific chronic disease groups in the current study. Long-term randomized controlled trials that incorporate multiple-level interventions are needed to enhance PA among older adults.

## Practical Implications

The findings of the current study have several practical implications for WAT design and health interventions involving WATs. Many commercial WATs do not come with a detailed manual other than simple book leaflets and a URL for the users to refer to. It is assumed that the use is intuitive or users can go online to find additional information. As one of the primary barriers to WAT adoption among older adults was lack of knowledge, WAT manufacturers or researchers attempting to use WATs as health promotion devices may consider developing detailed manuals with screen captures and visual illustrations of features, buttons, and navigation in the app, especially if the target users are older adults who are used to having a hard-copy manual. Step-by-step instructions of use may be a good way to educate older adult users who are not technologically savvy [68]. If the promotional materials of the WAT manufactures highlight the easiness of use, older adults may be more likely to take an action to adopt the WAT.

Skepticism regarding the accuracy of WATs and their ability to capture various physical activities was another major barrier to adoption and WAT use maintenance. WAT designers and manufacturers could include in their promotional materials explanations of how the WAT works and acknowledge that WATs cannot capture all activities including bicycling and swimming due to the nature of the accelerometers used in WATs for tracking activity. However, users should be able to manually enter the data of these activities not captured by WATs and still get an estimate of equivalent "step count" based on type, intensity, and duration.

Physical appearance and comfort were cited by many users, both long-term and short-term. Therefore, making the band of the WAT to be similar to a bracelet or another piece of jewelry that can match outfits or express identity seems to be a good strategy. This may be especially useful when individuals are already at the maintenance stage of behavior change to keep them engaged.

Many former users complained about WAT battery life, and it was identified as one of the primary reasons for abandonment. Battery capacity is an issue when the WAT is designed to be small. However, since we know that older adults prefer to have a bigger screen, we suggest that when WAT designers are faced with the dilemma of a small sized WAT and larger battery capacity, they should put priority on battery life when creating technology for older populations to ensure sustained use.

Social support was considered to be a major facilitating factor among long-term users to use WATs to keep physically active. Although friendly competition was mentioned by some long-term participants, the majority of them relied on not competition, but cooperation or collaboration—working together to be physically active. This indicates that WAT designers may add features to WATs and their associated apps to facilitate social support and the concept of working-out or walking together with family and friends.

## Conclusion

Our research suggests that there is no “magic bullet” approach to ensuring that older adults will use WATs on a long-term basis. Focusing on individual, interpersonal, and community level factors that predict the maintenance of WAT use behavior will likely be needed to help older adults effectively use WATs to become and stay more physically active. In addition, WAT developers and manufacturers should consider the design aspects that may be most relevant for older adults, given the rapidly increasing size of this demographic group around the world.

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Table 1. Number of Sources and References for Codes and Code Categories (sources/references[a])

| Themes | | Non-users before WAT trial | Non-users after WAT trial | Short-term users | Former users | Long-term users | TOTAL |
|---|---|---|---|---|---|---|---|
| **Ideal tracker: Prettier, bigger, and more comfortable** | ***Wish list of WAT features*** | **2/55** | **2/61** | **2/45** | **2/62** | **2/75** | **10/298** |
| | Comfortable band | 1/4 | 1/13 | 2/5 | 2/8 | 2/8 | **8/38** |
| | Aesthetics | 2/5 | 2/7 | 2/6 | 1/3 | 2/10 | **9/31** |
| | Better vision features | 1/4 | 2/13 | 2/5 | 1/1 | 2/6 | **8/29** |
| | Ease of use | 2/3 | - | 1/4 | 1/8 | 1/5 | **5/20** |
| | Tracking unique activities | 2/10 | 1/2 | 1/3 | 1/4 | 1/1 | **6/20** |
| | Compatibility with other devices | 1/1 | 1/3 | 1/3 | 1/4 | 2/6 | **6/17** |
| | Waterproof | 1/1 | - | 1/3 | 1/4 | 2/4 | **5/12** |
| | Calorie count | 2/6 | - | 1/1 | 1/2 | 2/2 | **6/11** |
| | Motivational messages, alerts | - | 1/3 | 1/2 | 1/3 | 2/3 | **5/11** |
| | Device size | - | 1/1 | 2/2 | 1/4 | 1/3 | **5/10** |
| | Heart rate and pulse | 1/6 | - | - | 1/1 | 2/2 | **4/9** |
| | Battery, charging | - | 1/1 | 1/3 | 1/2 | 2/3 | **5/9** |
| | WAT as a watch | 1/2 | - | - | - | 2/6 | **3/8** |
| | Accurate, reliable | 1/1 | 1/1 | - | 1/4 | 1/1 | **4/7** |
| | Sleep tracking | 1/3 | - | 1/1 | - | 1/2 | **3/6** |
| | Multifunctionality | 1/2 | 1/2 | 1/2 | - | - | **4/6** |
| | Customization | 1/1 | - | - | 1/3 | 2/2 | **4/6** |
| | Tracking physical progress | - | - | - | 1/1 | 2/3 | **3/4** |
| | Voice recognition | 1/1 | - | - | - | 1/2 | **2/3** |
| | ***WAT features used and liked*** | **1/3** | **2/27** | **2/23** | **2/22** | **2/73** | **9/148** |
| | Steps, walking | 1/1 | 1/1 | 1/4 | 2/6 | 2/14 | **7/26** |
| | Sleep tracking | - | 2/3 | 2/2 | 2/6 | 2/7 | **8/18** |
| | Heart rate and pulse | - | 1/2 | 1/6 | - | 2/9 | **4/17** |
| | WAT as a watch | - | 2/5 | 1/1 | - | 2/9 | **5/15** |
| | Band | 1/2 | 2/3 | 1/1 | 1/2 | 2/4 | **7/12** |
| | Waterproof | - | 2/3 | 1/2 | - | 2/5 | **5/10** |
| | Compatibility with other | - | 1/2 | 2/2 | 1/1 | 2/4 | **6/9** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | devices | - | - | 1/2 | - | 2/7 | **3/9** |
| | Motivational messages, alerts | - | 1/1 | - | - | 2/5 | **3/6** |
| | Tracking distance over time | - | 1/1 | - | 1/2 | 1/2 | **3/5** |
| | Battery and charging | - | - | - | - | 2/2 | **2/2** |
| | Calories burned | | | | | | |
| | ***WAT features that are not used*** | **-** | **2/4** | **1/1** | **2/3** | **2/22** | **7/30** |
| | Sleep tracking | - | 1/1 | - | - | 2/7 | **3/8** |
| | Calories consumed | - | 1/1 | - | 1/1 | 2/4 | **4/6** |
| | Stopwatch | - | 2/2 | - | - | 1/2 | **3/4** |
| **Maintaining WAT use: Trial, togetherness, opportunity, and internal motivation** | **Reasons to launch WAT use** | **2/17** | **2/4** | **2/10** | **2/10** | **2/20** | **10/61** |
| | Awareness of activity | 1/4 | 2/3 | 2/5 | 1/3 | 2/4 | **8/19** |
| | Curiosity | 2/6 | 1/1 | 2/3 | - | - | **5/10** |
| | Become more active | 1/1 | - | 1/1 | 1/2 | 2/2 | **5/6** |
| | Improve health, manage illness | - | - | - | 2/2 | 2/5 | **4/7** |
| | Seeing success of others | - | - | - | 2/2 | 2/3 | **4/5** |
| | Lose weight | 1/2 | - | - | - | 1/1 | **2/3** |
| | **Motivation** | **2/30** | **2/45** | **2/44** | **2/43** | **2/141** | **10/303** |
| | Awareness of activity | 1/5 | 2/16 | 2/6 | 2/8 | 2/25 | **9/60** |
| | Long-term health benefits | 1/4 | 1/9 | 2/3 | 1/2 | 2/25 | **7/43** |
| | WAT use as a competition, game | 1/2 | 1/2 | 2/8 | 1/9 | 2/21 | **7/42** |
| | | 1/2 | 1/3 | 2/8 | 2/3 | 2/26 | **8/42** |
| | Social support | 2/7 | 1/4 | 2/9 | 2/15 | 2/2 | **9/37** |
| | WAT does not motivate | 1/3 | 1/6 | 2/5 | - | 2/20 | **6/34** |
| | Goal setting | - | 1/1 | - | 1/1 | 2/8 | **4/10** |
| | Seasonal and weather changes | 1/2 | - | - | 1/1 | 2/4 | **4/7** |
| | Internal motivation | 1/1 | 1/1 | 1/2 | - | 1/2 | **4/6** |
| | Health condition, illness | - | - | - | - | 2/4 | **2/4** |
| | Life changes | | | | | | |
| | **Forming a WAT use habit** | **2/4** | **1/6** | **2/6** | **2/9** | **2/38** | **9/63** |
| | Creating an opportunity | 1/2 | 1/3 | - | 2/5 | 1/8 | **5/18** |
| | Creating and using prompts | - | - | 2/2 | 1/2 | 1/5 | **4/9** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | It's hard to start | - | - | - | - | 2/6 | **2/6** |
| **What's stopping 'em: Data inaccuracy as a demotivator** | **Barriers** | **2/55** | **2/59** | **2/59** | **2/54** | **2/50** | **10/277** |
| | Accuracy | 2/32 | 2/32 | 2/30 | 1/25 | 2/11 | **9/130** |
| | Technology hard to use | 2/3 | 2/11 | 2/11 | 2/6 | 2/3 | **10/34** |
| | Instructions | 1/1 | 2/9 | 1/1 | 1/2 | 2/4 | **7/17** |
| | Physical limitations | 1/2 | 1/4 | 2/5 | 1/2 | 2/4 | **7/17** |
| | Poor battery quality | - | - | 1/1 | 2/9 | 2/6 | **5/16** |
| | Price | 1/6 | 1/4 | 1/3 | 1/2 | - | **4/15** |
| | Emotional | 1/5 | 1/3 | - | 1/1 | 2/4 | **5/13** |
| | No interest | 1/5 | 1/3 | - | - | - | **2/8** |
| | Physical activity is not a priority | 1/1 | 1/1 | 1/2 | 1/2 | 1/1 | **5/7** |
| | Environmental | - | 1/2 | 1/1 | 1/2 | 1/1 | **4/6** |
| | Lack of privacy | - | - | 1/4 | - | - | **1/4** |
| | **Reasons to stop WAT use** | **2/4** | **2/8** | **2/7** | **2/37** | **1/2** | **9/58** |
| | WAT defect | 1/1 | - | 2/3 | 2/16 | - | **5/15** |
| | Awareness of activity reached | 1/2 | - | - | 2/6 | - | **3/8** |
| | Not compatible with other devices | - | 2/5 | 1/1 | 1/2 | - | **4/8** |
| | Lost WAT | - | - | - | 2/3 | - | **2/3** |
| | Inaccurate data | - | 1/1 | 1/1 | 1/2 | - | **3/4** |
| | Uncomfortable band | - | 1/2 | 1/1 | 2/2 | - | **4/5** |
| | WAT does not meet expectations | - | - | - | 1/1 | 1/1 | **2/2** |
| **Sample characteristics** | **Meaning of health**[b] | **2/33** | **-** | **2/17** | **2/33** | **2/34** | **8/117** |
| | Freedom and independence | 2/7 | - | 2/5 | 2/8 | 2/9 | **8/29** |
| | Moving | 2/9 | - | 2/4 | 2/6 | 2/7 | **8/26** |
| | Mental health | 2/6 | - | 1/1 | 1/1 | 1/5 | **5/13** |
| | Life quality | 2/4 | - | 2/3 | 2/4 | 2/2 | **8/13** |
| | Social engagement | 1/1 | - | 2/2 | 2/4 | 1/1 | **6/8** |
| | Being happy | 1/1 | - | 1/1 | 2/3 | 1/2 | **5/7** |
| | Eating well | - | - | - | 2/2 | 2/5 | **4/7** |
| | Not taking medicines | 1/1 | - | - | 2/3 | - | **3/4** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Participant self-descriptions**[b] | **2/15** | **2/4** | **2/13** | **2/21** | **2/22** | **10/75** |
| | Not tech-savvy, laggard, luddite | 2/3 | - | 1/1 | 2/8 | 2/6 | **7/18** |
| | Having had health issues | 1/1 | 1/1 | 2/5 | 1/5 | 2/2 | **7/14** |
| | Early adopter, tech-savvy | 1/1 | - | 1/1 | - | 2/6 | **4/8** |
| | Having been active | 1/1 | - | 2/4 | 1/2 | 1/1 | **5/8** |
| | **Favorite technology**[b] | **2/18** | **-** | **1/4** | **2/16** | **2/24** | **7/62** |
| | Computer (laptop, desktop) | 2/3 | - | 1/1 | 2/7 | 2/9 | **7/20** |
| | Phone | 2/2 | - | 1/3 | 2/3 | 2/9 | **7/17** |
| | Tablet computer | 2/4 | - | - | 2/3 | 2/4 | **6/11** |
| | E-reader | - | - | - | 1/2 | - | **1/2** |
| | **WAT associations**[b] | **2/8** | **1/4** | **1/2** | **2/21** | **2/11** | **8/46** |
| | WAT as a pedometer | 1/1 | - | 1/1 | 2/9 | 2/2 | **6/13** |
| | Other technology as WAT (apps) | - | - | - | 2/9 | 2/6 | **5/15** |
| | Wristband | 1/1 | - | - | 1/2 | - | **2/3** |
| | Health | 1/1 | 1/1 | - | - | - | **2/2** |

[a] sources = number of focus groups; references = number of mentions

[b] data used for sample descriptions

| Table 2. Participants' demographic information | | | | | |
|---|---|---|---|---|---|
| Characteristic | Non-users | Short-term users | Former users | Long-term users | All users |
| **N** | 17 | 9 | 11 | 11 | 48 |
| **Average Age** | 72.9 | 72.2 | 68.9 | 68.0 | 70.8 |
| **Standard Deviation** | 7.5 | 9.9 | 2.5 | 3.1 | 6.7 |
| **Age Range** | 66-94 | 66-94 | 67-73 | 65-73 | 65-94 |
| **Race/Ethnicity** | | | | | |
| **White** | 88% | 82% | 100% | 82% | 81% |
| **African American** | 0% | 18% | 0% | 18% | 9% |
| **Hispanic** | 6% | 0% | 0% | 0% | 6% |
| **Asian** | 6% | 0% | 0% | 0% | 6% |
| **Gender** | | | | | |
| **Male** | 41% | 18% | 18% | 18% | 41% |
| **Female** | 59% | 82% | 82% | 82% | 59% |
| **Education** | | | | | |
| **High School** | 12% | 0% | 0% | 0% | 4% |
| **Some College** | 18% | 18% | 18% | 18% | 15% |
| **College** | 41% | 46% | 18% | 46% | 36% |
| **Graduate** | 24% | 36% | 64% | 36% | 45% |

| Table 3. Participants' chronic conditions, physical activity levels, and WAT use length | | | | | |
|---|---|---|---|---|---|
| | Non-users n=17 | Short-term users n=9 | Former users n=11 | Long-term users n=11 | All users |
| **CHRONIC CONDITIONS** | | | | | |
| **Arthritis** | 47% | 33% | 73% | 55% | 52% |
| **High blood pressure** | 41% | 67% | 55% | 27% | 46% |
| **Obese** | 12% | 44% | 18% | 27% | 23% |
| **Thyroid condition** | 18% | 33% | 18% | 18% | 21% |
| **Heart disease** | 6% | 22% | 27% | 9% | 15% |
| **Diabetes** | 6% | 44% | 18% | 0% | 15% |
| | | | | | |
| **PHYSICAL ACTIVITIES** | | | | | |
| **Biking** | 18% | 68% | 64% | 18% | 38% |
| **Callisthenic classes** | 18% | 11% | 45% | 18% | 23% |
| **Weight lifting** | 24% | 33% | 73% | 27% | 38% |
| **Gardening** | 24% | 68% | 64% | 55% | 48% |
| **Walked** | 77% | 56% | 91% | 82% | 77% |
| **Water aerobics** | 35% | 11% | 18% | 27% | 25% |
| | | | | | |
| **FREQUENCY OF PHYSICAL ACTIVITY** | | | | | |
| **0 times per week** | 6% | 0% | 10% | 9% | 6% |
| **Once per week** | 12% | 0% | 10% | 0% | 6% |
| **2-3 times per week** | 35% | 44% | 30% | 36% | 36% |
| **4-5 times per week** | 41% | 33% | 10% | 18% | 28% |
| **More than 5 times a week** | 6% | 22% | 40% | 36% | 23% |
| | | | | | |
| **AVERAGE LENGTH OF WAT USE** | 0 months | Less than 3 months | 10 months (before abandonment) | Over 12 months | 8 months |

Table 4. Technology ownership by focus group type

| | Non-users | Short-term users | Former users | Long-term users | All users |
|---|---|---|---|---|---|
| **Access to a landline phone (N = 46)** | 69% | 89% | 67% | 50% | 67% |
| **Access to a mobile phone (N = 48)** | 88% | 89% | 100% | 86% | 92% |
| **Access to a desktop computer (N = 48)** | 77% | 89% | 67% | 72% | 77% |
| **Access to internet-enabled laptop computer (N = 47)** | 65% | 78% | 100% | 71% | 77% |
| **Access to tablet computer (N = 48)** | 65% | 78% | 100% | 100% | 81% |
| **Access to a WAT (N = 48)** | 0% | 100% | 67% | 100% | 58% |