Taylor & Francis
Taylor & Francis Group

Disability and Rehabilitation

ISSN: 0963-8288 (Print) 1464-5165 (Online) Journal homepage: https://www.tandfonline.com/loi/idre20

Patients' experiences with commercially available activity trackers embedded in physiotherapy treatment: a qualitative study

Darcy Ummels, Emmylou Beekman, Albine Moser, Susy M. Braun & Anna J. Beurskens

To cite this article: Darcy Ummels, Emmylou Beekman, Albine Moser, Susy M. Braun & Anna J. Beurskens (2020) Patients' experiences with commercially available activity trackers embedded in physiotherapy treatment: a qualitative study, Disability and Rehabilitation, 42:23, 3284-3292, DOI: 10.1080/09638288.2019.1590470

To link to this article: https://doi.org/10.1080/09638288.2019.1590470

DISABILITY AND REHABILITATION
2020, VOL. 42, NO. 23, 3284–3292
https://doi.org/10.1080/09638288.2019.1590470

Taylor & Francis
Taylor & Francis Group

RESEARCH PAPER

OPEN ACCESS Check for updates

Patients' experiences with commercially available activity trackers embedded in physiotherapy treatment: a qualitative study

Darcy Ummels[a,b,c], Emmylou Beekman[a,b,c], Albine Moser[a,b], Susy M. Braun[b,d] and Anna J. Beurskens[a,b]

[a]Research Centre for Autonomy and Participation of Persons with a Chronic Illness, Zuyd University of Applied Sciences, Heerlen, Netherlands; [b]CAPHRI School for Public Health and Primary Care, Maastricht University Medical Centre, Maastricht, Netherlands; [c]ParaMedisch Centrum Zuid, Physical Therapy Section in Multidisciplinary Centre, Sittard, Netherlands; [d]Research Centre for Nutrition, Lifestyle and Exercise, Faculty of Health, Zuyd University of Applied Sciences, Heerlen, Netherlands

ABSTRACT

Aim: The aim of this study was to describe the experience with commercially available activity trackers embedded in the physiotherapy treatment of patients with a chronic disease.

Methods: In a qualitative study, 29 participants with a chronic disease participated. They wore an activity tracker for two to eight weeks. Data were collected using 23 interviews and discussion with 6 participants. A framework analysis was used to analyze the data.

Results: The framework analysis resulted in seven categories: purchase, instruction, characteristics, correct functioning, sharing data, privacy, use, and interest in feedback. The standard goal of the activity trackers was experienced as too high, however the tracker still motivated them to be more active. Participants would have liked more guidance from their physiotherapists because they experienced the trackers as complex. Participants experienced some technical failures, are willing to share data with their physiotherapist and, want to spend a maximum of €50,-.

Conclusion: The developed framework gives insight into all important concepts from the experiences reported by patients with a chronic disease and can be used to guide further research and practice. Patients with a chronic disease were positive regarding activity trackers in general. When embedded in physiotherapy, more attention should be paid to the integration in treatment.

➤ IMPLICATIONS FOR REHABILITATION

- Activity trackers are perceived by patients with a chronic disease, as motivating them to be more physically active and to reach daily activity goals.
- The standard goal of 10.000 steps of the activity trackers is often perceived as too high, patients with a chronic disease would like to make a personal activity goal together with their physiotherapist.
- Patients with a chronic disease experience commercially available activity trackers often as too complex for their technical skills, they would like more guidance from their physiotherapist about the use and interpretation of an activity tracker.

ARTICLE HISTORY
Received 24 September 2018
Revised 28 February 2019
Accepted 1 March 2019

KEYWORDS
Activity tracker; wearable; chronic disease; physiotherapy; physical activity; patient perspective; experiences; framework analysis

Introduction

Activity trackers are increasing in popularity, with the top five brands combined selling 102.4 million activity trackers worldwide in 2016 [1]. These activity trackers are primarily targeted at a healthy and athletic population, but they might have potential for other specific groups such as those in healthcare. In 2016 almost 9 million people in the Dutch population (52%) suffered from one or more chronic diseases, with neck- and back pain, osteoarthritis and Diabetes Mellitus in the top three [2]. Over 90% of the inhabitants who are 70 years or older have one or more chronic diseases, the prevalence in inhabitants younger than 40 years is already 35% [2]. There is a positive relationship between physical activity and reduced premature death and the prevention of chronic diseases [3–5]. For example, sufficient physical activity can reduce pain for people with osteoarthritis, can effectively control fasting and post-walk blood sugar levels in patients with Diabetes Mellitus and can reduce the risk of emergency admission in patients with chronic lung diseases [3]. An adequate level of physical activity is one of the main points stressed in daily clinical practice, especially in physiotherapy, and recommended in evidence-based professional guidelines [6,7]. Therefore, people with a chronic disease are a target group par excellence for additional support through monitoring and objectively measuring physical activity in daily life.

Physiotherapists provide professional support with tailored advice on lifestyle changes [6] based on physical activity level and activity time distribution per day. They use questionnaires and diaries to measure the physical activity levels of their participants. However, questionnaires and diaries are time-consuming, have

CONTACT Darcy Ummels darcy.ummels@zuyd.nl Research Centre for Autonomy and Participation of Persons with a Chronic Illness, Zuyd University of Applied Sciences, P.O. Box 550, Heerlen 6400 AN, Netherlands

Supplemental data for this article can be accessed here.

limited reliability and validity and depend on the patient's memory [8,9]. A promising alternative to overcome these limitations is activity trackers. They can provide an objective measurement of the person's physical activity level, give insight into the distribution of physical activity levels during the day, and may motivate people to enhance their daily activity level [10]. The use of activity trackers in healthcare can aid in monitoring treatment results in the patient's daily life, increasing self-management, saving time and money, while addressing the actual setting where the lifestyle change should be achieved.

A good quality measurement device is important for implementation purposes. Several publications can be found regarding the clinimetric properties, validity and reliability of activity trackers [11–14]. Activity trackers have been shown to be valid during walking and running, however in daily living, activity trackers have a lower validity in people with a chronic disease [11–14].

Another important property concerns feasibility, i.e., experiences with activity trackers in healthcare. In this context, feasibility is understood as an umbrella concept, including experiences regarding user-friendliness as well as acceptability and usefulness in daily practice.

Feasibility aspects such as user-friendliness and sustained use of activity trackers have been studied in healthy adults [15–22] and the elderly [23–28]. From these studies it appears that in general, healthy adults and the elderly are open and positive towards the use of activity trackers. However, most studies argue that more attention should be paid to user experiences and lack of technical skills of the user. This may also lead to a more sustained use of the activity trackers in daily life.

By contrast, little is known about the experiences with activity trackers embedded in the healthcare of people with chronic diseases. Only two studies have described several important experiences and needs of people with a chronic disease, such as wearing comfort, feedback, validity, reliability and the added value of feedback [29,30]. However, they did not focus on the experiences with the use of the activity trackers in healthcare. To incorporate activity trackers in healthcare, like physiotherapy treatment, insight into feasibility from the perspective of people with a chronic disease who use activity trackers in a healthcare setting must be generated.

Therefore, the aim of this study was to describe how patients with a chronic disease experienced the use of commercially available activity trackers embedded in physiotherapy.

Methods

A qualitative design was used, based on the tenets of qualitative inquiry [31], using interviews and a focus group discussion to collect data. A framework study was used to analyze the data.

Participants

Participants were people with chronic diseases under treatment by physiotherapist. The inclusion criteria were diagnosed with at least one of the following chronic diseases: cardiovascular disease, chronic obstructive pulmonary disease (COPD), diabetes mellitus (DM), chronic pain, cancer or osteoarthritis. Exclusion criteria were: insufficient understanding of the Dutch language, use of a walking aid, or an asymmetrical gait. Participants were recruited via purposive sampling [32] based on their chronic disease from two physiotherapy practices (Fysiotherapie Schaesberg and ParaMedisch Centrum Zuid) and a rehabilitation center (Adelante Zorggroep) in The Netherlands. All participants provided written informed consent after receiving verbal and written information about the research. This study was approved by the local ethics board (METC Atrium-Orbis-Zuyd; 15-N-48).

Activity trackers

Eight activity trackers were selected based on characteristics such as wearing position, type of activity tracker and trackable activities, and on selection criteria required by the physiotherapists (costs less than €150, no monthly subscription, real-time feedback from the tracker to the user, measures number of steps, and no chest strap to measure heart rate). The following eight activity trackers were selected: Activ8, Digi-Walker CW-700, Fitbit Flex, Lumo Back, Moves, Fitbit One, UP24, and the Walking Style X (Table 1) [33]. Participants were provided with an activity tracker by their physiotherapist and asked to wear it for at least a week. Intentionally, physiotherapists received no specific instructions regarding to the way activity trackers should be distributed. The choice was made in consultation with the participant (shared decision-making) or was made by the physiotherapist solely. At their own request, participants could wear the activity tracker longer and could also use a second activity tracker. The physiotherapists had two training sessions: one about the practical use of the activity tracker (e.g., how to install them) and one about the integration of activity trackers in their therapy. Physiotherapists did not receive any further instructions about how to use the activity trackers in their treatments, to simulate 'real life' as much as possible.

Data collection

For socio-demographic purposes, the participants' general characteristics were collected: gender, age, diagnosed chronic disease, and the highest level of education. Specific disease characteristics were collected. In the case of COPD, this was the Global Initiative for Chronic Obstructive Lung Disease (GOLD) stage [34], for osteoarthritis its location (lower extremity, upper extremity, cervical or lower spine), and in cancer patients the treatment phase (curative/palliative). Two questionnaires were used: the Physical

Table 1. Eight selected commercially available activity trackers used in this study.

Activity tracker	Manufacturer	Type	Wearing position	Outcome variables
Activ8	Remedy Ltd	Accelerometer	Trouser pocket	A,B,C
Digi-Walker CW-700	Yamax Coorporation	Pedometer	Wrist	A,C
Flex	Fitbit Inc.	Accelerometer	Wrist	A,C
Lumo Back	Lumo BodyTech, Inc.	Accelerometer	Lower back	A,B,C,D
Moves	ProtoGeo	App	Trouser pocket	A,C
One	Fitbit Inc.	Accelerometer	Belt	A,C
UP24	Jawbone	Accelerometer	Wrist	A,C
Walking Style X	Omron Healthcare Europe B.V.	Pedometer	Belt	A,C

A: number of steps; B: time spent lying, sitting, standing, walking, running and cycling; C: active minutes; D: number of sit to stand transition.

Activity Questionnaire (PAQ) and the Cumulative Illness Rating Scale (CIRS). The PAQ was used to indicate the daily physical activity of the participants [35], and the CIRS was used to calculate the severity and number of comorbidities [36,37].

Participants were asked to participate in an individual interview or focus group discussion. A semi-structured interview guide for the individual interviews was developed based on the five steps of Kallio et al. [38]. In step 1, the appropriateness of the semi-structured setup was verified as a rigorous data collection method in relation to the research question of this study. In step 2, previous knowledge was retrieved from the literature and by consulting experts (two participant representatives, the research team and, two mHealth experts) to understand the phenomenon of feasibility, i.e., experiences with activity trackers in healthcare. In step 3, the preliminary interview guide was formulated. In step 4, the interview guide was tested by means of internal testing: evaluation within the research team, expert assessment with two participant representatives, and field testing with the first two research participants. Adaptations were made, and in step 5, the complete semi-structured interview guide was finalized. The interview guide is provided in Supplement File 1. The questioning route used for the focus group discussions was developed according to Krueger et al. [39]. The questioning route for the focus group discussion was based on that of the individual interviews to confirm data saturation.

The interviewers were a physiotherapist (EB) or a human movement scientist (KvV). The interview questions were open-ended to encourage the participants to talk about their experiences. If needed, the interviewer asked follow-up questions to gain more insight. Individual interviews were performed at a location convenient for the participant (either the participant's home or the physiotherapy practice). Each interview was audio recorded and lasted 30–60 min; the interviewer also took field notes. The focus group discussion took place at the research institute (Zuyd University). The focus group discussion was audio recorded and lasted for 60–90 min. There was one interviewer (EB), two researchers took field notes (KvV, AB) and two participant representatives were present.

Participants were included until no new information was collected (data saturation) on all topics. This was established by regular agreement sessions within the research team. Once data saturation had been reached, one focus group discussion was scheduled, which served to confirm the results.

Data analysis

The data were analyzed according to the Framework Method [40]. In stage 1, all audio recordings were transcribed verbatim by two researchers (DU, KT) and primary identifiers were de-identified. In stage 2, the entire transcripts were read and, if needed for the context of the text passage, the audio recordings were reviewed. In stage 3, paraphrases or labels (a code) were applied to relevant text fragments. Deductive and inductive content analysis was used [41]. Deductive content analysis was used for the majority of codes predefined according to empirical information [16–19,22–24,29,30,42–47]. Inductive coding was applied when the text passages did not fit a predefined code but were considered to be relevant. An 'other' code was defined to include such data. During the analysis, two subcategories were added to the framework: choice of activity tracker and discussing results with a physiotherapist. In stage 4, the first two interviews were coded by both researchers (DU, KT). An alignment session was held with the two researchers and one other independent researcher (EB) to fine-tune the coding. Differences in interpretation were solved by a dialog between DU and KT to reach consensus, because the aim was the find a suitable interpretation grounded in the original quote. The codes were grouped together into categories and subcategories by the research team, using a tree diagram. Expert assessment of this working analytical framework took place in four iterative expert meetings with two participant representatives, the research team, and two mHealth experts. In stage 5, the analytical framework was applied by indexing subsequent transcripts using the existing categories and codes (see Supplement File 2). In stage 6, the data were entered into the framework matrix from a spreadsheet including a summary and a reference to illustrative quotations. In addition, an analytical tabulation was performed. Finally, in stage 7, the data were interpreted and presented in a descriptive way using NVivo (version10).

Descriptive statistics of the participants' characteristics were presented. Means (± standard deviation) or medians (range) (depending on the data distribution) were given. If data were missing, pairwise deletion was applied.

Trustworthiness

To ensure the quality and trustworthiness of this study, credibility and transferability were checked in several ways [31]. Credibility was examined by method, investigator and data triangulation. Method triangulation involved multiple methods of data collection (interviews and focus group discussions); investigator triangulation was achieved by having all authors reflect on the design, data collection and analysis process during this study; and data triangulation used different sources of the same information (multiple interviewees and participants in focus group discussions). Transferability was examined through a thick description of our study population and the study process [31].

Results

The framework analysis resulted in eight categories: 1) purchase of the activity trackers, 2) instruction, 3) characteristics of the activity tracker, 4) correct functioning, 5) sharing data, 6) privacy, 7) use of the activity tracker, and 8) interest in feedback. The

Table 2. Demographic and health characteristics of included participants.

Characteristics	Participants (n = 29)
Gender, n male (%)	7 (27)
Age (years), median (range)	55 (22–78)
Education, n (%)	
Secondary Education	6 (26)
College	9 (39)
University	8 (35)
Diagnosed disease, n (%)	
Cardiovascular Disease	1 (4)
COPD	2 (8)
Diabetes Mellitus	1 (4)
Cancer	5 (20)
Osteoarthritis	4 (16)
Chronic Pain	10 (40)
Combination	2 (8)
Comorbidity (CIRS 0-52), median (range)	5 (0–10)
Physical activity*	
Sufficiently active, n (%)	14 (59)
Insufficiently active, n (%)	10 (41)

*Physical activity was measured by the physical activity assessment tool to determine whether the participants was sufficiently active [35]. There was three missing values for gender (10,3%), age (10,3%), six missing values for education (20.6%), four missing values for diagnosed disease (13.7%) and CIRS score (13.7%) and, five missing values for physical activity assessment tool (17.2%). COPD: Chronic Obstructive Lung Disease; CIRS: Cumulative Illness Rating Scale.

number of quotes per (sub)category is presented in Supplement File 2.

Participants

A total of 23 participants were interviewed individually, and six participants participated in the focus group discussion (Table 2); all wore the activity tracker for between two and eight weeks. The Activ8 was the most used activity tracker ($n = 6$), followed by the Fitbit Flex ($n = 5$), Fitbit One ($n = 5$), Digiwalker CW-700 ($n = 4$), UP 24 ($n = 4$), Walking Style X ($n = 4$), the Moves app ($n = 2$) and, the Lumoback ($n = 1$). Four participants used two different activity trackers, two participants tested three different activity trackers, and one participant tested four different activity trackers.

Chronic pain, osteoarthritis, and cancer were the most prevalent conditions, and 8% of the participants had multimorbidity. Of the participants with COPD, one patient had been diagnosed with stage II COPD, and one patient didn't know his GOLD stadium. Of the participants with cancer, 50% had had a curative treatment and 50% a palliative treatment; this variable was missing for one participant. Of the participants with osteoarthritis, the most affected joints were the upper extremity (41%), spine (36%) and lower extremity (23%).

Purchase of the activity trackers

Most of the participants were unfamiliar with activity trackers and had no idea about their average cost. Some of the participants had heard that activity trackers were expensive. When asked about how much they were willing to pay, participants said they would be willing to spend between 20–50 euros but that there should be no other costs, e.g., subscription fees. Some participants wanted to buy an activity tracker but refrained due to the perceived high costs.

> "I would spend 20-30 euros if I am sure the activity tracker works. But I can get one for 5 euros of which I am not sure if it works." Female, 28 years, chronic pain

> "We subscribed somewhere so we could get a discount on a Fitbit. My husband asked if he should buy one for me. But I think it is way too expensive" Female, 57 years, cancer

Some looked for reimbursement options and consulted their insurance company. If healthcare insurance companies offered some form of compensation, then participants would consider buying an activity tracker at the average retail price.

> "I already called the health insurance company to see if they reimburse it [activity tracker] but they don't." Female, 65 years, Diabetes Mellitus and cardiovascular disease

One other difficulty in purchasing an activity tracker was the lack of information about them. The amount of effort needed to find information hindered them from buying one. According to the participants, there was no clear information available on the internet. Participants wanted an aid that compared several activity trackers. They suggested one that would specify the characteristics, brand, advantages and disadvantages of a small number of activity trackers and where they could be obtained. Some participants also suggested linking this to their physiotherapist's website or providing information in the physiotherapist practice.

> "Well a scheme, with the possibilities and for example a picture and where you can buy it [activity tracker]. Or which brand, what the advantages and disadvantages of some are. Or the complexity." Female, 46 years, chronic pain

Participants found that activity trackers did not function on Apple products (MacBook, iPad) and that some older computers can't run the activity tracker software. They experienced this as disappointing. However, they would not buy another computer or smartphone so they could use their activity tracker.

Instruction and use

Older participants said that if they had received more information from their physiotherapists about using the activity tracker, they could have used them independently. Some participants consulted the physiotherapist for additional information. Almost all had to ask their partner, children, or physiotherapist for extra help.

> "I didn't understand how to do it, so I called my physiotherapist again and we went through it together one more time, after that it went fine." Male, 66 years, Diabetes Mellitus and cardiovascular disease

> I installed the activity tracker together with my husband. I have to admit, I don't have that much technical skills, but together we managed to do it. Female, 61 years, chronic pain

Most participants mentioned that their physiotherapist installed the activity tracker for them. Some participants had asked their physiotherapist to read out their data. Others claimed that by embedding activity trackers in the care process, the physiotherapist needed to focus on several aspects in daily clinical practice: a thorough explanation of the activity tracker, advice on the suitable moment(s) of checking individual data on the trackers and help with the translation of the activity tracker data into a conclusion for the patient on how he is doing ('data interpretation').

> "In the light of embedding in healthcare, the physiotherapist should pay more attention to explaining the activity tracker, and the meaning of it, but he should also help with the interpretation of the results." Male, 56 years, cardiovascular disease

With some activity trackers, an instruction guide was included, yet experiences with these guides varied between participants. Some participants found the instructions very clear, while others said they were too vague. Many participants would like a clear step-by-step manual. One major issue was that the guides were written in English instead of the participants' mother tongue (Dutch). But even if the manual was written in Dutch, the activity tracker itself, the apps and web portals were still in English instead of Dutch, which still made them hard to understand and operate.

> "Well, make it clear, add a Dutch manual with it, how the install it [activity tracker] and stuff like that." Female, 57 years, cancer

Most participants felt that their technical abilities were insufficient. The most commonly expressed explanation was their age. Participants were reluctant to try different settings and buttons on the activity tracker as they might do something wrong and lose the data.

> "No, well, I always think, don't touch it, you never know what you can do wrong. My son works in IT, and he always says: Mom, you can't do that, you can always get it [data] back." Female, 66 years, cardiovascular disease and cancer

Some wrote down the data on paper and brought it to the consultation with the physiotherapist because they feared they would lose data and damage the activity tracker.

> "I think if I do this, I lose everything. Maybe it is very easy if you would do it. But I am afraid that I would do something wrong. I prefer to watch and write down the time and date and number of steps. I take the note with me and say: This is what I have done. I am afraid that I

would break something again, and I don't want that." Female, 70 years, chronic pain

Characteristics of the activity tracker

Participants expressed that activity trackers should be as easy to use as possible (e.g., one button). It was hard for them to navigate and find their data in the corresponding app or computer dashboard. Because of the technical and procedural complexity of the activity tracker, they did not try to understand it fully. Some felt if they had tried harder, they would have understood the activity tracker better.

"I did find the number of steps, but you had to push buttons to get more information, so you really needed to search. How do I find what I want and what does it all mean? I just didn't think it was practical." Male, 41 years, chronic pain

This complexity demotivated them to search for the information on the app or dashboard.

"Especially number of steps and the walked distance, I had to search for the rest. You really had to look how to get more information. Sometimes I don't feel like searching for it." Male, 41 years, chronic pain

The activity trackers measure several variables, and most participants were interested in their number of steps, calories, sleep pattern and walked distance. When specifically asked, some participants would have liked to have variables related to swimming, cycling, and a heart rate monitor. The option to register their food and liquid intake was hardly used.

"It should register all kind of movement, such as cycling and walking, and I would like to measure my heartrate and blood pressure as well." Female, 60, chronic pain

Most participants used the interface of the activity tracker itself to check their data and to receive feedback, provided that the text on the activity tracker was legible. Participants checked their data regularly, varying from once a day to several times during the day. Some participants would have liked an overview of their physical activity during the week, in the form of a graph. Participants appreciated the visual stimulant.

"I saw that I was above the line, which was enough for me. But it would be nice, not every day, but once a week for example that you can see the difference with yesterday in a simple way." Female, 66 years, cardiovascular disease and cancer

Most participants focused on the number of steps as a daily goal, while some used the number of calories, but the majority took the standard goal of the activity tracker, the 10,000 steps. For many, this standard goal was too high, though almost no one altered it. The most common personal health goal of the participants was to walk more or lose weight. Some participants mentioned they did not have a specific goal but wanted to gain insight into their physical activity or into the relationship between their physical activity and their chronic disease or rehabilitation process.

"When I used to come home from the clinic where I was treated, I couldn't do anything. I could walk three steps. That has a certain progression. I would have liked to oversee this whole process. What was I able to do yesterday and what am I able to do now?" Male, 62 years, osteoarthritis

The preferred place to wear the activity tracker was a trouser pocket attached with a clip, though several women preferred wearing the activity tracker attached to their bra.

"Yes, in my trouser pocket, always in my trouser pocket, like now. It doesn't bother me at all, I just have to remember it when I change my trousers." Male, 62 years, osteoarthritis

Most participants reported that the activity tracker should be discrete, easy to attach without assistance, and comfortable to wear. Sleeping with the activity tracker was uncomfortable for most participants.

"I liked the Fitbit One better, the small thing, that is because I don't like it if it [activity tracker] is visible" Female, 47 years, chronic pain

Some expressed concern that the activity trackers were not waterproof, or could easily be lost.

"I thought it was a pity it [activity tracker] wasn't waterproof. We still have to wash windows and do our dishes and stuff like that." Female, 60 years, chronic pain

The battery of the activity tracker lasted longer than expected. Participants appreciated the average lifetime of 3–4 weeks. They stated that there was a chance they would forget to recharge the activity tracker regularly.

Correct functioning

The experiences with the validity and reliability of the activity trackers varied. Small movements such as household activities were sometimes not measured. In some instances the activity tracker measured activities that were not actually performed by the participants.

"It [activity tracker] registered cycling but I never cycle and yet it popped up, for example, 20 minutes or something like that and I figured maybe I had made some kind of movement which is registered as cycling?" Female, 30 years, chronic pain

Participants noticed a lack of validity and reliability more often with activity trackers worn around the wrist. Sometimes, participants had technical problems such as trouble logging-in or synchronizing with the activity tracker.

"It could take up to a half hour before the activity tracker made a connection" Female, 47 years, chronic pain

Sharing data and privacy

Participants were positive about sharing data with their family or friends. This gave them a confirmation of their physical activity level and simultaneously challenged them to be more physically active.

"I used to do this with some friends from the North (of the Netherlands) and from here. I showed them how much I walked." Female, 74, osteoarthritis

None expressed reticence about sharing their data with healthcare professionals, and none wished to share their data with companies, including the manufacturer of the activity tracker.

"I don't think the data are privacy sensitive. If he [physiotherapist] can help me by having insight in the data, I can benefit from that of course." Female, 61 years, chronic pain

Use of the activity tracker

Participants used their activity tracker, but over time some of them forgot to wear or check it. The majority of participants did not discuss their physical activity data with their physiotherapist, though when asked, some admitted they would have liked to do so. Only a few discussed their results with their physiotherapist and created new activity goals together. The data were verbally

discussed without using the activity tracker's interface. None of the participants wanted to discuss the data during their treatment session, since they valued the treatment delivered by the physiotherapist more than any substitution of treatment by the data of the activity tracker. Another reason was that some of the participants received group therapy and did not want to request extra time from their physiotherapist.

> "If the physiotherapist should read out the data and explain them, that would take too much time away from my treatment" Male, 63 years, osteoarthritis

Only when asked, participants thought it would be motivating to discuss the data with their physiotherapist. As this wasn't the case, most did not recognize the added value of the activity tracker.

> "I: Would it [activity tracker] be an added value to your therapy?"

> "P: Yes, I don't know what could be discussed. Well, it isn't right or wrong. So maybe some kind of guideline, I think you have moved too little or something like that? That is always nice to hear. Whether you do something with it depends on yourself of course. I still don't know what average is, that is a nice thing what I would like to know." Female, 44 years, chronic pain

Participants found it demotivating to deal with unrealistically high goals. Participants would have liked to create an individual goal together with their physiotherapist. Some became too active for their condition, which led to physical complaints. A few used the goals as a 'brake' to limit their physical activity.

> "Well it [step count goal] is not achievable. And you start to think, 'I won't make it anyway', so it should be achievable goals" Female, 47 years, chronic pain

Interest in feedback

All participants, except one, perceived the feedback of the activity tracker as positive and pleasant. One perceived the feedback as negative, due to a decline in his health. They used the feedback as a motivator to reach their goals; almost all stated that they went for an extra walk or climbed some more stairs to achieve their target. However, it was demotivating when participants noticed that the activity trackers did not measure certain activities (cycling, walking stairs).

> "I started walking through the gallery and the living room just to … It really has been a challenge, but at some point it became obsessive. If I open that thing [activity tracker] at 22.00 and I thought, 'Oh no, these are not a thousand steps, I should do a little more'. So I ran at the end of the day through my home just to make more steps." Female, 73 years, cancer

Participants also reported that they became more aware of their physical activity level in general.

> "I think when it [number of steps] is visible, it will motivate you to complete the task." Male, 66 years, cancer

The visual stimulant of achievement, for instance a growing flower or a smiley, was well received by almost all participants. It motivated them to gain a reward from the activity tracker (e.g., fully grown flower). Some appreciated that feedback was an objective measurement.

> "I think it [activity tracker] stimulates you to walk more because it is visible. If you don't have it [activity tracker], then you don't of course." Female, 75 years, osteoarthritis

Discussion

The aim of this study was to describe how patients with a chronic disease experienced the use of commercially available activity trackers embedded in physiotherapy treatment in order to increase successful implementation in future care. The participants used an activity tracker for at least one week and were then interviewed about their experiences. In general, they experienced the use of the activity trackers as positive and enjoyed using them. The activity trackers motivated them to increase their physical activity levels and reach their daily goals, and, they became aware of their physical activity. However, they experienced certain limitations, such as the complexity of the activity tracker, doubts about its validity and reliability, the lack of clear instructions for using the activity tracker by the physiotherapist, and high standard goals set by the activity tracker. The majority of the participants did not discuss their activity tracker data with their physiotherapists, as the treatment delivered by the physiotherapist was valued more than the data of the activity tracker.

The results of the interviews are in line with previous studies [29,30] in which the acceptance and usefulness of activity trackers in their daily life for people with a chronic disease was examined. Mercer et al. concluded that activity trackers were perceived as acceptable and useful, but the participants needed support in setting up the device and interpreting the data [29]. Rosenberg et al. also concluded that men with prostate cancer perceived activity trackers as acceptable but found several barriers to their use such as problems with syncing the activity trackers and data inaccuracies [30]. Activity trackers should be as straightforward as possible, with personal demonstrations and written manuals provided. Mercer et al. and Rosenberg et al. both suggested that usability could be improved by having more compatible computers and smartphones, comprehensive paper manuals, and apps that interpret the user data. Studies among the elderly and adults [15–28] showed considerable similarities with the results of this study and those of Mercer et al. and Rosenberg et al. Older people and adults accepted the activity tracker, found them stimulating, increased awareness, and experienced them as useful. However, especially elderly stated they would prefer an activity tracker which is easier to use and adapted to their needs and skills. Adults prefer an activity tracker adapted to their routines and needs, and like to have a more accurate (i.e., reliable and valid) activity tracker.

In this study, a framework analysis was used to analyze the data, resulting in a framework with seven categories: 1) purchase of the activity trackers, 2) instruction, 3) characteristics of the activity tracker, 4) correct functioning, 5) sharing data and privacy, 6) use of the activity tracker, and 7) interest in feedback. Each category had several subcategories. The two themes, all categories and sub-categories, except for four subcategories, of the framework were consistent with the literature used. Two new sub-categories were added during the analysis of the interviews: choice of the activity tracker and discussing results with a physiotherapist. A final framework was produced which includes all of the important concepts from the experiences reported by people with a chronic disease after using activity trackers and can guide the use in further research and practice.

Limitations and strengths

This study has certain strengths and limitations. The activity trackers used were the most up-to-date at the time of the study. However, some manufacturers stopped producing these specific kinds of tracker or stopped producing activity trackers entirely,

while several new activity tracker brands and updated versions have been released with new functions. To the authors' knowledge, though, none of these activity trackers are designed for people with a chronic disease or even the healthcare sector in general. However, the concepts of the framework are general and still applicable to updated versions and new brands.

The length of time the participants used the activity tracker varied. Every participant used the activity tracker for at least one week, and they were free to use the activity tracker for a longer period of time if they desired. This might have influenced their experience since they would become more familiar with the tracker. Some participants used more than one activity tracker, which may also have biased their experience since they might have compared the activity trackers during the interview. This might also have intensified the experiences, resulting in enriched data in this study.

One strength of this study is the use of the Framework Method, which has been used in research for over 25 years [41]. Some of its strong points are: data can be easily summarized, the structure is visually easy to interpret, it can be used with inductive and deductive analysis, the systematic procedure is easy to follow and has a clear audit trail [41].

Another strength of this study is the implementation of the activity tracker in physiotherapy treatment. The participants were free to use the activity tracker any way they liked, but almost none used it in their physiotherapy treatment. One explanation was that they valued the treatment for their physical complaints more than discussing their physical activity data. The participating physiotherapists received two training sessions and no further instructions about the use of the activity tracker in their daily practice. This information was probably too limited and more training including show cases is needed. It might be possible that physiotherapists therefore had too limited knowledge how to imbed the use of activity trackers in their treatment. The participants may also have not seen the added value of an activity tracker during their therapy, due to lack of guidance from their physiotherapist. If embedded correctly, activity trackers can potentially contribute in a positive way to the physical behavior of a patient.

Clinical relevance

Activity trackers can potentially be of added value to physiotherapy, but the feasibility of the activity tracker must be optimal to ensure implementation in physiotherapy treatment. The findings in this study are novel, physiotherapists should be aware of several factors which might compromise the use of an activity tracker during physical therapy. First, activity trackers should be easy to use in daily life and during treatment. An activity tracker should match with the needs and technical skills of the patient, but currently patients experience them as too complex. Participants who have limited technical skills need regular guidance from their physiotherapist besides help with interpretation of activity tracker data for all patients.

At this moment, most of the participants did not see the added value of an activity tracker, since they didn't discuss the activity tracker data during their therapy and valued the physical treatment more. However, when asked, participants could see the potential added value of an activity tracker. Therefore, if a physiotherapist wants to use an activity tracker in therapy, they should use it in a meaningful way to support the physical treatment. An activity tracker can be a good measurement- and motivation tool in physiotherapy treatment since participants found them motivating to be more active and to reach their daily activity goals. However, some activity trackers are not yet valid and reliable during activities of daily living. This should be kept in mind by both the physiotherapists and patient, since this might demotivate the patient and influence the advice of the physiotherapists. Furthermore, due to the perceived high costs, most participants are not willing to buy an activity tracker themselves. A physiotherapist should keep in mind that therefore the use of an activity trackers might not be affordable for every patient depending on their finical situation and willingness to buy an activity tracker.

Conclusion

Patients with a chronic disease were positive regarding activity trackers in general. However they require an activity tracker adapted to their needs and skills. The developed framework gives insight in all important concepts from the experiences reported by people with a chronic disease and can be used to guide further research and practice. When embedded in physiotherapy, however, more attention should be payed to the integration in treatment.

Acknowledgements

The authors would like to thank all (consortium)partners: Hanze University of Applied Sciences, Hospital Nij Smellinghe, Fontys University of Applied Sciences School of Sport Studies, Maastricht University, Paramedisch Centrum Zuid, Fysiotherapie Schaesberg, Revalidatiecentrum Adelante, Royal Dutch Society for Physical Therapy and, Burgerkracht Limburg. The authors also would like to thank Kim van Vijven and Kyra Theunissen for their contributions (data collection and analysis) during this study.

Ethics approval and consent to participate

This study was approved by the local ethics board (METC Atrium-Orbis-Zuyd; 15-N-48). Written informed consent was obtained from participants. All information was handled with strict confidentiality.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the Stichting Innovatie Alliantie [2014–01-54P] and Brightlands Innovation Program Limburg Meet.

Availability of data

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

References

[1] International Data Coroporation [Internet]. Wearables Aren't Dead, They're Just Shifting Focus as the Market Grows 16.9% in the Fourth Quarter, According to IDC. Framingham: International Data Coroporation; 2017 [cited 2017 Nov 17]. Available from: https://www.idc.com/getdoc.jsp?containerId=prUS42342317

[2] National Institue for Public Health and Enviroment [Internet]. Chronische ziekten en multimorbiditeit→Cijfers & Context→Huidige situatie. Bilthoven: National Institue for Public Health and Enviroment; 2017 [cited 2018 Feb 7]. Available from: https://www.volksgezondheidenzorg.info/onderwerp/chronische-ziekten-en-multimorbiditeit/cijfers-context/huidige-situatie
[3] C3 Collaborating for Health. The benefits of regular walking for health, well-being and the environment. London: C3 Collaborating for Health; 2012.
[4] Warburton DE, Nicol CW, Bredin SS. Health benefits of physical activity: a systematic review of current systematic reviews. Curr Opin Cardiol. 2006;174:801–809.
[5] Booth FW, Roberts CK, Laye MJ. Lack of exercise is a major cause of chronic diseases. Compr Physiol. 2012;2:1143–1211.
[6] Fysionet-evidencebased [Internet]. Introduction physical activity intervention. Amersfoort: Royal Dutch Society for Physical Therapy, 2013 [cited 2017 Jun 7]. Available from: https://www.fysionetevidencebased.nl/images/pdfs/beweeginterventies/inleiding_bij_de_kngf-standaarden_beweeginterventies.pdf
[7] World Health Orginsation. Global recommendations on physical activity for health. Switzerland: World Health Orginsation; 2010.
[8] Ainsworth B, Cahalin L, Buman M, et al. The current state of physical activity assessment tools. Prog Cardiovasc Dis. 2015;57:387–395.
[9] Helmerhorst HJ, Brage S, Warren J, et al. A systematic review of reliability and objective criterion-related validity of physical activity questionnaires. Int J Behav Nutr Phys Act. 2012;9:103.
[10] Sullivan AN, Lachman ME. Behavior change with fitness technology in sedentary adults: a review of the evidence for increasing physical activity. Front Public Health. 2016;4:289.
[11] Ummels D, Beekman E, Theunissen K, et al. Nine commercially available activity trackers in people with a chronic disease for activities of daily living: a cross-sectional validity study. JMIR Mhealth Uhealth. 2018;6:e70.
[12] Kooiman TJ, Dontje ML, Sprenger SR, et al. Reliability and validity of ten consumer activity trackers. BMC Sports Sci Med Rehabil. 2015;7:24.
[13] Ferguson T, Rowlands AV, Olds T, et al. The validity of consumer-level, activity monitors in healthy adults worn in free-living conditions: a cross-sectional study. Int J Behav Nutr Phys Act 2015;12:42.
[14] Van Remoortel H, Giavedoni S, Raste Y, et al. Validity of activity monitors in health and chronic disease: a systematic review. Int J Behav Nutr Phys Act. 2012;9:84.
[15] Epstein DA, Kang JH, Pina LR, et al. Reconsidering the device in the drawer: lapses as a design opportunity in personal informatics. Ubicomp; 2016 Sep 12–16; Heidelberg, Germany.
[16] Lazar A, Koehler C, Tanenbaum J, et al. Why we use and abandon smart devices. Ubicomp; 2015 Sep 7–11; Osaka, Japan.
[17] Harrison D, Marshall P, Bianchi-Berthouze N, et al. Activity tracking: barriers, workarounds and customisation. Ubicomp; 2015 Sep 7–11; Osaka, Japan.
[18] Shih PC, Han K, Poole ES, et al. Use and adoption challenges of wearable activity trackers. iConference; 2015 Mar 24–27; Newport Beach, California, USA.
[19] Armağan K, Çiğdem E. Design for physical activity: design aspects of wearable activity trackers. International Conference of Engineering Design; 2015 Jun 27–30; Milano, Italy.
[20] Maher C, Ryan J, Ambrosi C, et al. Users' experiences of wearable activity trackers: a cross-sectional study. BMC Public Health. 2017;15:17880.
[21] Hermsen S, Moons J, Kerkhof P, et al. Determinants for sustained use of an activity tracker: observational study. JMIR Mhealth Uhealth. 2017;5:e164.
[22] Karapanos E, Gouveia R, Hassenzahl M, et al. Wellbeing in the making: peoples' experiences with wearable activity trackers. Psychol Well Being. 2016;6:4.
[23] Fausset CB, Mitzner TL, Price CE, et al. Older adults' use of and attitudes toward activity monitoring technologies. Proceedings of the human factors and ergonomics society; 2013 Sep 30–Oct 4; San Diego, CA, USA.
[24] O'Brien T, Troutman-Jordan M, Hathaway D, et al. Acceptability of wristband activity trackers among community dwelling older adults. Geriatr Nurs. 2015;36:21–25.
[25] Rasche P, Schäfer K, Theis S, et al. Age-related usability investigation of an activity tracker. IJHFE. 2016;4:187.
[26] Preusse KC, Mitzner TL, Fausset CB, et al. Older adults' acceptance of activity trackers. J Appl Gerontol. 2017;36:127–155.
[27] Schlomann A. A case study on older adults' long-term use of an activity tracker. Gerontechnology. 2017;16:115–124.
[28] Puri A, Kim B, Nguyen O, et al. User acceptance of wrist-worn activity trackers among community-dwelling older adults: mixed method study. JMIR Mhealth Uhealth. 2017;5:e173.
[29] Mercer K, Giangregorio L, Schneider E, et al. Acceptance of commercially available wearable activity trackers among adults aged over 50 and with chronic illness: a mixed-methods evaluation. JMIR Mhealth Uhealth. 2016;4:e7.
[30] Rosenberg D, Kadokura EA, Bouldin ED, et al. Acceptability of Fitbit for physical activity tracking within clinical care among men with prostate cancer. AMIA Annu Symp Proc; 2016 Nov 4–8; Washington, USA.
[31] Lincoln YS, Guba EG. Naturalistic inquiry. USA: Sage publications; 1985.
[32] Palinkas LA, Horwitz SM, Green CA, et al. Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. Adm Policy Ment Health. 2015;42:533–544.
[33] Beekman E, Braun SM, Ummels D, et al. Validity, reliability and feasibility of commercially available activity trackers in physical therapy for people with a chronic disease: a study protocol of a mixed methods research. Pilot Feasibility Stud. 2017;3.
[34] Agusti A, Decramer M, Celli BR, et al. Pocket guide to COPD diagnosis, management and prevention. Global Initiative for Chronic Obstructive Lung Disease. 2017.
[35] Marshall AL, Smith BJ, Bauman AE, et al. Reliability and validity of a brief physical activity assessment for use by family doctors. Br J Sports Med. 2005;39:294–297.
[36] Linn BS, Linn MW, Gurel L. Cumulative illness rating scale. *J Am Geriatr Soc*. 1968;16:622–626.
[37] de Groot V, Beckerman H, Lankhorst GJ, et al. How to measure comorbidity. A critical review of available methods. J Clin Epidemiol. 2003;56:221–229.
[38] Kallio H, Pietila AM, Johnson M, et al. Systematic methodological review: developing a framework for a qualitative

semi-structured interview guide. J Adv Nurs. 2016;72: 2954–2965.
[39] Kreuger RA, Casey MA. Focus Groups a practial guide for applied research. Vol. 5. USA: SAGE Publications; 2015.
[40] Gale NK, Heath G, Cameron E, et al. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. BMC Med Res Methodol. 2013;13:117.
[41] Elo S, Kyngas H. The qualitative content analysis process. J Adv Nurs. 2008;62:107–115.
[42] van Bommel M, Van Gisbergen T. De eerste stap zetten. De hanteerbaarheid en toepasbaarheid van activiteitenmeters [bachelor thesis]. Heerlen (Netherlands): Zuyd University of Applied Science; 2015.
[43] Verwey R. Get moving! Self-management support using mobile technology. A counselling protocol extended with a web-based coaching system to promote physical activity in patients with COPD or type 2 diabetes in primary care: the It's LiFe! study [dissertation]. Maastricht: Maastricht University; 2015.
[44] Mancuso PJ, Thompson M, Tietze M, et al. Can patient use of daily activity monitors change nurse practitioner practice? J Nurse Pract. 2014;10:787–793.
[45] Andrieu N, Mannens L, Nowak K. Toepasbaarheid en hanteerbaarheid van activiteitenmeters binnen de ergotherapie bij COPD-patiënten [bachelor thesis]. Heerlen (Netherlands): Zuyd University of Applied Science; 2015.
[46] Lyons EJ, Lewis ZH, Mayrsohn BG, et al. Behavior change techniques implemented in electronic lifestyle activity monitors: a systematic content analysis. J Med Internet Res. 2014;16:e192.
[47] Stevens A, Beurskens A, Koke A, et al. The use of patient-specific measurement instruments in the process of goal-setting: a systematic review of available instruments and their feasibility. Clin Rehabil. 2013;27:1005–1019.