The Implementation, Actual Use and User Experience of an Online Home Exercise Program That Fits the Needs of Older Adults with Mild Cognitive Impairments

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Abstract: As the population ages, the number of people in our communities suffering with mild cognitive impairment (MCI) will increase. Individuals with MCI may benefit from e-health interventions for exercise promotion, but there is a need for such an e-health program that fits the needs of older adults with MCI. The objective of this study was to evaluate the implementation, actual use and user-experience of a home-based exercise program developed for older adults with MCI. Questionnaires were filled in about the implementation strategy, actual use and user-experience (usefulness, usability and satisfaction). Fifty-seven older adults and eight formal caregivers participated in the study. Mean duration of the sessions was 18 minutes (+/-15). The user-experience of the older adults was higher than that of the formal caregivers. Formal caregivers mainly offered the program at the home care organization, but some older adults indicated that they were willing to try it at home. In conclusion, the online exercise program is feasible and potentially beneficial for older adults when taking into account the e-health literacy of older adults and attitude towards e-health of formal caregivers in the implementation strategy.

1 INTRODUCTION

As the population ages, the number of people in our communities suffering with mild cognitive impairment (MCI) will increase (Alexander et al., 2015). Older adults with MCI have higher risks for decreased physical function (Marquis et al., 2002), increased chronic physical illness and increased levels of affective disturbance (Lopez et al., 2003), and increased mortality (Bennett et al., 2002). This will not only affect the quality of life of people with MCI, but will also increase the burden on family caregivers, community care, and residential care services. The support of independent living in the older adult population is important to preserve quality of life for as long as possible.

Due to the socioeconomic challenges to the healthcare systems, there is an urgent need for cost-effective support programs to increase the independent living of older adults with MCI (Prince et al., 2016). New e-health technologies are expected to contribute to providing this support. In this context, several studies highlight the potential of e-health programs, due to the increasing availability of internet access and the benefit of flexibility, facilitated accessibility, and personalization of these programs (Bujnowska-Fedak and Priogowicz, 2014, McKechnie et al., 2014). As most older adults with MCI reside in the community, an intervention designed for the home setting is especially advantageous.

Individuals with MCI may particularly benefit from e-health interventions for exercise and health promotion. There is promising evidence that exercise programs can improve the ability to perform activities of daily living in people with dementia (Forbes et al., 2015). A meta-analysis of randomized controlled trials by Heyn et al., (2004) reported beneficial effects of physical activity on physical fitness and cognitive function in adults with cognitive impairment.

To date, most research on e-health interventions to promote exercise and physical activity has excluded older adults with cognitive impairments (Savitch, 2006). There are only few published e-

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health studies specifically targeting people with cognitive impairment, such as MCI. These adults are thought to be unable to successfully complete the programs and assessments due to their limited use of everyday technology, such as mobile phones or computers (Malinowsky et al., 2017). Older adults do have more difficulty engaging with the internet for health care (Czaja et al., 2008), which has been partly attributed to poor website design, complex navigation requirements, and a lack of internet training (Czaja et al., 2013), factors that are secondary to cognitive decline and which should be addressed in the development of e-health for older adults with MCI.

As such, there is a need for an e-health program that fits the needs of older adults with MCI in promoting physical exercise. For this, we developed a home-based exercise program for older adults with MCI starting from an evidence-based home exercise program developed for pre-frail older adults (Dekker-van Weering et al., 2017). We used a participatory design to adapt the program to the needs of older adults with MCI (Dekker- van Weering et al., 2016). In this paper, we evaluate the implementation strategy, actual use and user experience of this program for older adults with MCI and their formal caregivers. This is in agreement with previous studies, which emphasized the need to conduct early evaluation studies such as "proof-of-principle-studies" to improve the use of e-health by older adults before the realization of studies on a larger scale (Makai et al., 2014).

2 METHODS

We conducted a qualitative evaluation study, between April 2016 and October 2017. The Medical Research Ethics Committee (MREC) Twente declared that this study does not meet the criteria necessary for an assessment by an accredited MREC according to Dutch law. All participants provided informed consent prior to participation in the study.

2.1 Participants and Setting

Participants recruited for this study were older adults and formal caregivers from Trivium Meulenbelt Zorg (TMZ). TMZ is a healthcare organization in the Netherlands for older adults with cognitive and/or physical impairments. TMZ has nursing homes, homes for elderly and home care. Inclusion criteria for older adults were: 1) receiving home care of TMZ; 2) having cognitive impairment or dementia; 3) living independently at home. Seven locations from TMZ were invited to participate in this study.

To recruit participants, the first author organized workshops to inform informal caregivers about the exercise program and asked them if they and the person they cared for were willing to participate. The formal caregivers were also informed about the inclusion criteria and based on that they asked their older adults to participate in this study.

2.2 The Intervention

The intervention was initially developed for pre-frail older adults in the PERSSILAA project (Dekker-van Weering et al., 2017). To make the program fit the needs of older adults with MCI, we organized a workshop with caregivers to define the adaptations needed to make it usable for older adults with cognitive impairments (Dekker- van Weering et al., 2016). The main adaptations made were:

- a maximum of 20 minutes of training instead of 30 minutes, due to decreased concentration capacities of this target population
- minimize the text and click options in the program, to increase ease of use
- exclude options for older adults to give feedback about the exercises
- an additional level with only sitting exercises, to accommodate for physically frail older adults

The intervention is a technology-supported exercise program, which older adults can perform on their own in their home setting. The contents of the exercise program was based on the Otago Exercise Programme (Robertson et al., 2001) which is an individually tailored fall prevention program with muscle strengthening and balance-training exercises. The exercises are functional and closely related to daily activities and are categorized in three categories: balance, strength, and flexibility. Each training session starts with a warming-up and ends with a cooling down. In the training session, older adults perform exercises in each category (balance, strength, and flexibility). The program consists of 17 exercises each time, which enables training for a maximum of 20 minutes. Video and spoken and written instruction guide the older adults through the exercise. Through a secure login, participants log in to a web portal to access the program.

The program progresses in five levels. These levels can be selected and adapted by the formal caregivers. Exercises are randomly and automatically chosen by the program according to the corresponding difficulty level. The first step-in

level of the program consists of light and easy exercises, which can be performed when sitting in order to accommodate for sedentary older adults. Progression of difficulty in levels elapsed in agreement with the older adult. Older adults were not obliged to finish all levels during the program. Older adults could see their progress in the training module, which tells them at what level they are training, which week and which session. After each training session, they get an overview of the exercises performed.

2.3 Implementation Strategy

From the start, formal caregivers indicated in the workshops that they felt insecure about providing the technology to older adults at home without any professional support. They suggested to provide the program in their care setting at first, preferably in a group and once the older adults are familiar with the technology, they could continue using it at home. Other formal caregivers thought that there would be some exceptions and some older adults might be able to use is at home instantly. To meet these initial thoughts, formal caregivers were free in how to offer the program to older adults. There were three options, which were explained to them:

1) Offer at TMZ location to a group of older adults with MCI; program is provided by a formal caregiver
2) Offer at TMZ location, older adults with MCI can train on his/her own;
3) Offer to the older adults with MCI at home, individually.

2.4 Procedure

All formal caregivers were instructed about the program and its content. They received accounts to log in to the webportal to access the program. Formal caregivers were free in how to offer the program to their older adults. Formal caregivers were instructed to use the online exercise program for a minimum of four weeks and at least once a week.

2.5 Outcome Measures

All older adults received paper-based questionnaires about demographics, living situation, everyday use of technology and cognitive functioning before the start of the study (T0) and after the end of the study (T1) about the implementation and user experience.

All formal caregivers received paper-based questionnaires about demographics and everyday use of technology at T0 and about the implementation and user experience at T1.

2.5.1 Demographic Variables

We collected demographic variables including age, sex, work status and cognitive functioning at baseline by means of a questionnaire as well as data about the use of internet and everyday use of technology of the participants. Cognitive functioning was measured with the Mini Mental State Exam (MMSE) (Kurlowicz and Wallace 1999). The range of MMSE score is from 0 (highest cognitive impairment) to 30 (not cognitive impaired) (Murden et al., 1991). A score between 19 and 23 is used to specify MCI (Tombaugh and McIntyre 1992).

2.5.2 Implementation

At the end of the study, a questionnaire was provided to the older adults with MCI and their formal caregivers. Formal caregivers were asked which of the three implementation strategies they had used and whether they thought the older adults were able to use the program themselves at home and potential barriers for independent use at home.

Older adults with MCI were asked in a questionnaire whether they felt able to use the program at home and if not, barriers for using the program in the home setting.

2.5.3 Actual Use

We used log data to analyze the actual use of the intervention. Actual use will be reported as duration and frequency of use and the level achieved by the users.

2.5.4 User Experience

To assess the experience of the user with the technology we will assess the constructs; perceived usefulness, usability, satisfaction, intention to use and willingness to pay.

The **perceived usefulness** was assessed at the end of the study by means of a questionnaire. The perceived usefulness for older adults was assessed on a 5-point Likert-type scale via the items:

- "*How useful do you think the exercise program was*" (1=very useful to 5=not useful at all)
- *"I think that the online exercise program improved my physical health and well-being"* (1=strongly agree to 5=not agree at all)

The perceived usefulness of formal caregivers was assessed on a 5-point Likert-type scale via the items:

- "*How useful do you think the exercise program was*" (1=very useful to 5=not useful at all)
- "*To what extent did the exercise program improve your quality of work*?" (1=a lot to 5=not at all)

In addition, participants were asked to name the advantages and disadvantages they experienced in using the exercise program.

Usability perceived by formal caregivers was measured with the System Usability Scale (SUS). The SUS is a short ten-item questionnaire to investigate the ease of use of the program (Brooke 1996). Rating of the SUS is from one (totally disagree) to five (totally agree) and the range is a score from 0 to 100. A score higher than 68 is considered as good usability, a score of 85 or higher as excellent usability and a score of 90 or higher indicates best imaginable. A score of 50 or lower is considered as poor or unacceptable usability (Bangor et al., 2009).

Based on the problems we experienced at T0 with older adults filling in the questionnaire, we decided to decrease the cognitive burden of the older adults. For older adults, we selected two items from the SUS:

- I thought the program is easy to use (SUS item 03)
- I would imagine that most people would learn to use this program very quickly (SUS item 07)

To assess the **satisfaction,** all participants were asked to rate the intervention on a scale from 1-10 and they were asked whether they would like to continue using the intervention in the future (**intention to use**). Formal caregivers were also asked whether they would recommend the program to other colleagues. In addition, older adults were asked whether they were willing to pay for the intervention to continue using it.

2.6 Data Analysis

IBM's Statistical Package for the Social Sciences (SPSS, 23) was used for the statistical analyses. Demographic variables and everyday use of technology were calculated as frequencies (percentage) and means (+/-SD). For evaluating the actual use of the intervention (duration, frequency, levels), log data were used. Means, standard deviations and frequencies were calculated for user experience measures to highlight the most important aspects.

3 RESULTS

3.1 Participant Characteristics

In total, 101 older adults and 8 formal caregivers participated in this study. Forty-four older adults dropped out before the start of the intervention. The reasons for dropping out were: the hospitalization (n=6), passed away (n=9); out of care (n=7), transfer to another location (n=3), didn't want to participate anymore (n=4), didn't like the program (n=2), being too busy (n=1), or not having enough digital skills (n=1) (missing reasons n=11).

Table 1 shows demographic variables and everyday use of technology of the participants. The mean age of the older adults was 80.2 (+/-10.8) years and most of the older adults were female and lived alone. Mean MMSE score was 24.1 (+/-5.9), indicating MCI. The everyday technology use was very low in this population, with more than half of the older adults not having a computer, tablet or smartphone at home. In addition, more than half of the older adults didn't have internet at home. The formal caregivers were all female and all of them had a laptop/ computer with internet at home.

Table 1: Participant characteristics and everyday technology use.

Variable	**Older adults with MCI (n=57)**	**Formal caregivers (n=8)**
Mean age in years (sd)	80.2 (10.8)	42.6 (14.5)
Gender, n (%)		
Male	13 (23)	0
Female	43 (75)	8
Retired, n (%)		
Yes	49 (86)	0
No	7 (12)	8
Living situation (n)		
I live with spouse/partner	17	
I live with family	5	
I live alone	34	
MMSE, mean (SD)	24.1 (5.9)	
Use of everyday technology at home (n)		
Computer/laptop yes/no	21/ 35 (missing 1)	8/0
Tablet yes/no	9/ 40 (missing 8)	5/3
Smartphone yes/no	3/ 46 (missing 8)	5/3
Access to internet at home, yes/ no (n)	15/34 (missing 8)	8/0

3.2 Implementation Strategy

The online exercise program was used at seven locations of TMZ in Twente, the Netherlands. All of the formal caregivers used the program in a group at the location (see figure 1) with 4-8 older adults participating in each session. Groups started the intervention incrementally. Six of the seven formal caregivers indicated that their older adults wouldn't be able to use the program at home, because of lack of a computer (n=2), fall risk (n=1), more burden on the informal caregiver (n=1) and/or lack of motivation (n=1). One formal caregiver indicated that some older adults might be able to use the program at home with proper support of a partner at home to help the older adult starting and using the program.

Figure 1: Group exercising at TMZ.

Only one of formal caregivers provided the program to older adults at home and she provided the program to eight older adults. Nine older adults indicated they would have been able to use the program at home, but weren't offered to by their formal caregiver. The other older adults indicated that they would not have been able to use the program at home for different reasons: lack of technologies (n=14); lack of digital skills (n=4); not offered by formal caregivers to be used at home (n=3); too scared to use it alone (n=2); cognitive impairments (n=2); physical impairments (n=1); lack of motivation (n=1); vision problems (n=1); not able to read (n=1).

3.3 Actual Use

The program was used at the different locations 125 times in total, with a mean duration of 18 minutes (+/-15). Formal caregivers selected only level 1 for exercising. In the home setting, the program has been used 32 times with a mean duration of 15 minutes.

3.4 User Experience

A lot of data of the older adults for the user experience questionnaires were missing, due to concentration problems, not understanding the questions, not willing to fill in the questionnaires and/or not remembering the program. All formal caregivers filled in the questionnaire.

Table 2: Advantages and disadvantages perceived by older adults.

Advantages	N	Disadvantages	n
Exercising together / social interaction	**33**	Not enough variation in the program	**14**
Physical improvements noticed	**23**	Program too long	**3**
Program enables to exercise more often	**12**	Unclarity of exercises	**3**
Good structure in the program	**5**	Technical failure of program	**2**
Being able to exercise at home	**1**	Program too easy	**1**
Gives some variation in the day	**1**	Exercises too heavy	**1**

Table 3: Advantages and disadvantages perceived by formal caregivers.

Advantages	n	Disadvantages	n
Exercising with a group/ social interaction	**4**	Not enough variation in the program	**6**
Program enables to exercise more often	**3**	Program suffered from technical Problems	**2**
Creating new ideas for exercising	**1**	Older adults are too good for the Program	**1**
Program creates something to talk about	**1**	Exercises were too long	**1**

3.4.1 Perceived Usefulness

Both formal caregivers (n=6) and older adults (n=46) perceived the program as useful. Twelve of the older adults' ratings (28%) indicated improvement in perceived physical health and emotional well-being, twenty older adults (47%) indicated this as neutral and 11 older adults (26%) didn't indicate improvements. Most of the formal caregivers (n=5) indicated that the program didn't improve their quality of work, one formal caregiver indicated that it improved a lot and two answered neutral.

Different advantages and disadvantages were mentioned about the program (see table 2 and 3). Table 2 shows that both older adults and formal caregivers liked the possibility to exercise together,

making it more fun. One older adult wrote: *"Exercising is important at our age. Exercising together motivates and is fun, doing it alone is unpleasant"*. Many older adults indicated physical improvements because of exercising with the program. For example, one older adult wrote: *"The exercises loosened my leg muscles and I felt better at night"*.

The main disadvantage mentioned by both older adults and formal caregivers was insufficient variation in the program. One quote that was heard a lot was *"we often had the same exercises; more variation would be more motivating"*.

3.4.2 Usability

The mean SUS score of the formal caregivers was 65.4 (+/- 12.5), indicating that the usability was "ok". For older adults answering the questions, most of them thought the program was easy to use (23 of the 29) and imagined that most people would learn to use it quickly (11 of the 18).

3.4.3 Satisfaction

Formal caregivers rated the system on average with a 6.0 (+/-1.4). Older adults rated the system with a 7.4 (+/-0.8). Considering the intention to use, 20 of the 46 older adults (43%) indicated that they would like to continue using the program after the end of the project and eight of those older adults (17%) would be willing to pay for the program. Twelve older adults (26%) indicated that they didn't want to continue using the program.

Two of the eight formal caregivers were willing to continue using the program after the project had ended and three of the eight formal caregivers recommend the program to other caregivers.

4 CONCLUSIONS

This study evaluated the implementation, actual use and user experience of a home-based exercise program for older adults with MCI.

We developed a program for exercising at home, with three implementation strategies considered beforehand. The implementation strategy that was used the most was the one offering the program in a group setting by a formal caregiver at the location of TMZ. As such, the majority of the older adults didn't use the program by themselves and many indicated that they would not have been able to use it because of lack of technologies and/or digital skills. This study shows that every day use of technology is still an issue in older adults with MCI. Computer literacy is a major barrier in other studies as well where e-health is being used independently by older people (Lee and Coughlin 2015). Despite the many potentials of e-health in this group, this will hamper the implementation in the future. This calls for e-health literacy interventions aiming at improving older adults' ability to access and use e-health applications (Korda and Itani, 2013). E-health literacy refers to the "*set of skills and knowledge that are essential for productive interactions with technology-based health tools*" (Chan et al., 2011). We recommend focusing on this e-health literacy in the implementation of the exercise program by the older adults and formal caregivers to enable older adults to make better use of the program in the future.

All formal caregivers started with offering the intervention in a group setting at location. However, the initial goal of this strategy of making older adults familiar with the technology at the location where after they would be offered the program at home, was not realized. In addition, only one caregiver felt secure in providing the intervention to older adults at home, despite the fact that some of the older adults indicated that they would have been willing to try the program at home. Formal caregivers only offered level 1 (exercises in sit) to the older adults, resulting in low variety in exercises and demotivation of older adults. This indicates that caregivers are still careful in what to provide to their older adults. Caregivers might be afraid to let go of control and this desire to maintain their control is seen in other studies as well as a barrier in e-health implementation (Grünloh et al., 2018). This indicates that formal caregivers need some support when implementing e-health to change their attitude towards using and providing it to older adults with cognitive impairments. There is still a need to educate formal caregivers to assess users' capacities, preferences, and motivation for using e-health (Kenigsberg et al., 2016).

Older adults were positive about the program. They thought the program would be easy to use, that they would be able to learn to use it quickly and a high amount of older adults would be willing to continue using the service (43%). They indicated several advantages, with physical improvements and exercising together being the most important ones. This social component is important to take into account, as this is seen as major facilitator for exercising in older adults (Resnick et al., 2002). To date, the program doesn't facilitate any social features, but this might be an important

improvement point to integrate in the home-based program. This might stimulate the older adults to use the program in the home setting as well. Unfortunately, the user experience was less positive for formal caregivers, despite several advantages mentioned. This usefulness was mainly perceived for the older adult and not for themselves as a caregiver. This was also reflected in the answer that the program didn't improve their quality of work. Despite the participatory design of the program, still a few adaptations need to be made in order for the program being accepted in the future by both older adults with MCI and their formal caregivers. It is important to increase the user experience of formal caregivers, because they play a key and pivotal role in the initiation and maintenance of exercise behaviour among the older population (Schutzer et al., 2004).

As internet technologies become further integrated into the lives of people across the lifespan, it seems likely that online training will not only become more accessible, but also more desirable, for older adults. The results of the current study suggest that this type of training approach is a useful supplement in the current care for older adults with MCI. The online exercise intervention is feasible and potentially beneficial for older adults with MCI when taken into account the e-health literacy of older adults in the implementation strategy and further adapting the program according to the results of this study.

4.1 Limitations

One of the limitations of the study was that older adults with low level of digital skills were overrepresented. As such, the program could not be used in the home setting as much as we had hoped. In the future, it might be helpful to include informal caregivers as well in order to help the older adult with MCI with the use of the program at home. In addition, there were many missing values in the questionnaire due to cognitive impairments of the older adults. This has limited the evaluation. In many cases, older adults couldn't remember the program. In addition, this target group probably had difficulty in reading or perceiving information, and this could explain part of the not-so-positive scores in the usability assessment. This sensory accessibility could have played an important role and more attention should be payed to the type and amount of questions asked to decrease the burden of the older adult with MCI and the timing of the evaluation.

4.2 Future Work

Further development of the program is necessary for older adults with MCI to be able to use it and to increase the user experience of the formal caregivers. It seems helpful to develop an e-health literacy module in the implementation strategy, for both older adults and formal caregivers. Future research should focus on changing the attitudes of formal caregivers towards using e-health in the care of older adults with MCI and motivate them to offer it in the home setting.

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