Developing a Digital Gaming Intervention with Yetitablet® to Improve Older People's Functioning and Activity in Long-Term-Care – a Feasibility Study

Saara Kukkohovi[1](✉), Heidi Siira[1], and Satu Elo[2]

[1] University of Oulu, Aapistie 5 A, 90220 Oulu, Finland
saara.kukkohovi@oulu.fi
[2] Oulu University of Applied Sciences, Kiviharjuntie 4, 90220 Oulu, Finland

Abstract. Long-term care (LTC) residents often have many health problems and functional limitations, and their sedentary behavior is common. Playing digital games is one way to improve the well-being, functioning, and activity of older people. The purpose of this study was to test a digital gaming intervention with a new device in an LTC environment before the larger effectiveness study. The aim was to produce information on the benefits of the digital gaming intervention for residents, the success of the implementation of the intervention and the factors affecting it. One LTC facility for older people participated in the study. The data was collected with a semi-structured thematic interview after an eight-week intervention. The interview data was analyzed using inductive content analysis. Staff experiences of the benefits of the intervention were classified into three main categories: The intervention enabled a new kind of physical activity, the intervention increased the social activity and brought residents together and the intervention brought joy and variety to the residents. Success of the intervention implementation was classified into three main categories: active participation of the residents in the gaming sessions, low involvement of staff in the implementation of the intervention and variable success of implementing the intervention protocol in the everyday life of LTC facility. Factors affecting the implementation formed nine main categories. This feasibility study highlighted important factors related to the implementation of the intervention, which must be considered in the future for the success of the effectiveness study.

Keywords: Digital games · functioning · activity · long-term care · older people

1 Introduction

1.1 Background

Long-term care (LTC) residents often have many health problems and functional impairments. It has been noticed that physical activity of care dwelling older people is significantly lower than community dwelling older people [1] and older women living in LTC

M. Särestöniemi et al. (Eds.): NCDHWS 2024, CCIS 2083, pp. 207–222, 2024.
https://doi.org/10.1007/978-3-031-59080-1_15

have been observed to spend over 70% of their time sitting or lying during daytime [2]. Lower level of physical activity is associated with more symptoms of anxiety and depression and lower physical performance [3, 4]. Time spent in weight bearing positions and activities is associated with better balance and physical performance while sedentary time is associated with reduced muscle strength, balance, and physical performance [2]. Sedentary time and functional impairments weaken ability to cope with daily activities and the quality of life, and thus cause an increased need for care and caring resources.

One of the promising ways to improve the well-being, functioning and activity of older people is digital gaming which is traditionally used as a leisure activity for younger people. Digital games are played on a digital device such as a tablet computer or a video game console. Nowadays the term serious games is also used, which means that playing has a serious purpose such as exercise, health, or rehabilitation [5]. The effectiveness of digital gaming on the functioning and activity of older people has been studied over the past ten years, and the results have been promising. Digital gaming has been found to improve balance, mobility, and gate [6, 7], promote social interaction [8], and reduce loneliness [9] and depression also on older people with memory disorder [10].

Despite the benefits of digital gaming, the implementation of it in LTC's everyday life can be challenging. The cost of these games is usually not very high [6] but there might be other barriers for implementation of digital games in LTC. These are for example lack of space, lack of the time required for staff to introduce games to residents and older people's lack of competence in using technology [6, 8]. Healthcare professionals may feel insecure about their own digital skills [11] and attitudes towards new technologies may be rejective, which reduces motivation to adopt new technologies [12]. Also, all the games and devices are not designed for the use of older people [8] and may therefore require quick response, hand-eye coordination, jumping, reaching, or other activities that can be challenging for the older people and require repetition and practice to successfully complete the game.

Mostly used and studied gaming device in LTC environment is Nintendo Wii [13] but in addition, new games and devices are designed and developed for the older people to meet their special needs [14–16]. There is not much scientific research evidence yet available on the effectiveness of these new technologies on the functioning and activity of older people. Also, the focus of digital game research has been on independently living and healthy older people, so there is a need for game research conducted in the context of long-term care and with population who already has functional decline in many areas. In many previous interventions games have been guided for LTC residents mainly by research staff but this study is carried out in the everyday life of a LTC facility, and the staff implements the digital gaming intervention. Previous digital gaming research has also focused on physical performance, and there is still only little research that considers the social and psychological aspects of gaming [13, 17].

1.2 Objectives

The aim of this study was to test the implementation of digital gaming intervention on a small scale before the full-scale effectiveness study to detect its possible problems. The objective was to obtain information on the feasibility of the intervention and the factors influencing the successful implementation of it, obtain preliminary information on the

benefits of the intervention on long-term care residents' functioning and activity, and test the performance of functional capacity measurements for LTC-residents. We also wanted to test the use of activity monitors with this population which will be used in the future effectiveness study to gain information about changes in physical activity.
Research questions were:

1. What benefits does the digital gaming intervention have on the functioning and activity of the residents?
2. How does the implementation of the intervention succeed?
3. What factors influence the implementation of the intervention?

2 Methods

2.1 Study Design, Setting and Participants

This was a qualitative feasibility study. One long-term care facility located in Northern Finland participated in this study. The LTC facility and participants were selected by purposeful sampling. Both residents of the facility and the staff were invited to participate in the study. Facility residents were invited to participate in the intervention and staff were invited to participate in the post-intervention interview. Participants of the intervention were selected between February and March 2023 according to the inclusion and exclusion criteria by the personnel of the facility who knew the residents well. Inclusion criteria to participate in this study were: 1) able to walk (independently) at least 10 m with or without walking aid 2) sufficient cognitive ability to understand the purpose of the study and instructions for the gaming 3) does not have any disease that would prevent light exercise 4) does not have any acute severe disease 5) living permanently in the facility. Exclusion criteria were: 1) not able to walk independently or with walking aid 2) severe memory disorder or other severe or acute illness 3) too poor vision to play games 4) is receiving some other treatment which may affect the change in functioning or activity. The researcher introduced the study to suitable residents, distributed the research information forms and inquired about their interest in participating in the study. The intern working in the facility contacted the relatives of the residents and delivered the consent forms to sign. Facility staff and interns who participated in the intervention's implementation were invited to participate in the post-intervention interviews.

2.2 Intervention

Eligible residents participated in an eight-week digital gaming intervention with a Finnish innovation, a Yetitablet (picture 1). Yetitablet is a large tablet computer with 55–65″ screen utilizing Android operating system. Yetitablet has a touch screen and a mobile stand on wheels, which allows the screen to be raised and lowered, as well as tilted as needed, all the way to a desk position. Large screen size enables group activities and social interaction. Yetitablet includes YetiCare software which gives Yetitablet an accessible user interface and has many stimulating applications for entertainment, rehabilitation, and physical exercise [18] (Fig. 1).

Fig. 1. Yetitablet and YetiCare applications

The development of the intervention started by conducting a systematic literature review on the previously implemented digital game interventions and their effectiveness on the functioning and activity of older people in a long-term care setting [13]. The dosage and duration of the intervention were determined based on this review.First, a one-hour training session was held for the facility staff. A member of the YetiCare company introduced the Yetitablet and advised how to use it remotely via Teams. After the introduction the principal investigator presented the intervention and guided staff in testing the Yetitablet and its games. During the intervention, study participants could choose the games and the amount of gaming because it better reflects the real-life situation and gives a true picture of the effects in a long-term care environment on this population. However, facility personnel were instructed to organize three gaming sessions per week, lasting for about half an hour to one hour. The personnel were instructed to consider the players' physical and cognitive functioning and coping when directing the games and to adjust the game session according to the participants' resources. Games were encouraged to be played with about four participants or more. As the intervention progressed, instructions were given to consider the progression of participants so that a more challenging level was selected for the games, and playing would take place as much as possible in a standing position. All persons working in the unit could carry out the intervention. A logbook was given for the facility and gaming session instructors were asked to mark down every playing sessions' date, duration, participants, and games played during the session. The logbook also contained instructions for the intervention, for example what games could be played, how to make progress to the program, playing in a standing position and in groups. The Yetitablet and logbook were placed in a large multiuse room next to the dayroom.

YetiCare applications (later: games) were classified into the following categories in the Yetitablet: coordination, motor skills, smart games, and entertainment. YetiCoordination included games like darts, bowling and YetiCups (picture 2). These games are

played by throwing soft balls at the screen. Also, YetiReaction, YetiCups and YetiBubbles were included in the coordination category, but those games are played by touching the screen. These games require reaction ability, body and movement control and balance if games are played in a standing position. Motor skills category included games like YetiForms, YetiGather and YetiMaze. In these games a player must use fine motors skills in the upper limbs to reach the goal of the game such as moving an object from the starting point to the finish line through a labyrinth. YetiBrain Games included games like a memory game, guess the word –game and a word grid. These games require short term memory, attention, and perceptiveness. Entertainment category included games like table hockey or football, tic-tac-toe, and trivia. Although these games are classified as entertainment, playing them requires for example concentration, quick reactions, body control and weight shifting if played standing up. The staff were instructed to use the YetiCare gamified applications, but they were also allowed to use other content downloaded to the tablet such as Google Maps, newspapers, card games, sudoku and sensory applications. The staff and/or residents could choose the games played during the gaming sessions (Fig. 2).

Fig. 2. Example of YetiCare coordination game, YetiCups

2.3 Data Collection

Qualitative data was collected during this study to obtain information on the intervention's benefits to the residents and its feasibility. Data was collected from the facility staff through a semi-structured thematic interview [19]. Two interns working at the facility at the time of the intervention and one permanent facility staff member participated. The interviewees were a nurse, an occupational therapist student and a geronomy student. Interviews were carried out after an eight-week intervention period in June 2023 via Teams and recorded with the permission of the participants. Two participants were interviewed together and one alone for scheduling reasons. The group interview lasted

59 min and the interview with one participant lasted 28 min. The interviews proceeded according to pre-planned themes which were attitudes towards the intervention and new technology, benefits of intervention for residents, the strain caused by the intervention on staff and residents, implementation of the intervention and usability of the Yetitablet. In addition, the personnel were asked for their thoughts and suggestions for changes related to the intervention protocol. The interview questions were based on earlier research about technology acceptance [20] and ICF framework [21]. The material was transcribed and the total number of transcribed material was 16 pages with the text type Times New Roman, with font 12 with a line spacing of 1.5.

Functioning measurements were done to the residents participating in the intervention before and after the eight-week intervention to test the suitability of the measurements for the target group. Testing data was not analyzed in this study due to the small sample size. Measures done were Short Physical Performance Battery (SPPB) which measures the mobility of older people, and it combines the results of balance tests, gait speed and chair stand [22], Timed Up and Go test (TUG) which measures mobility and balance [23], Geriatric depression scale (GDS-15) which is developed for identifying depressive symptoms in the older people [24] and The Revised Index for Social Engagement (RISE) which measure social engagement among long-term-care facility residents [25].

2.4 Data Analysis

Qualitative data was analyzed by inductive content analysis [26]. The analysis began by reading through the transcribed material several times. Next, expressions (sentence or set of thoughts) that corresponded to the research questions were extracted from the data (n = 106) and grouped according to the research question. Original expressions were then reduced to a more condensed form and expressions with identical content were combined into a subcategory, which were named with descriptive names (n = 36). Finally, subcategories with the same content were grouped to form main categories (n = 15).

3 Ethical Considerations

The study was approved by the regional medical research ethics committee of the Well-being services county of North Ostrobothnia (reference number: 49/2021) and research permission was requested from the facility. The aim, objective and procedure of the study were presented to the eligible subjects and their relatives/close ones. After informing eligible subjects and their close ones, written informed consent was obtained from participants or their trustee. Participants had the right to withdraw from the study at any time.

4 Results

4.1 Characteristics of the Residents Participating in the Intervention

Out of 18 residents in the facility eight were eligible to participate in the study based on the inclusion criteria and one refused to participate due to old age. Four residents who participated in the intervention were men and three were women. The mean age of participants was 86 years (range 8198 years). Participants had multiple physical, sensory, and cognitive impairments. All participants had a diagnosed memory disorder, one had poor vision and two had osteoarthritis. Male participants did not have walking aids, but all participating women used a walker. A summary of baseline characteristics of the residents participating in the intervention is presented in Table 1.

Table 1. Baseline characteristics of the residents participating in the intervention

Variable	Sub-category	
Age in years, mean (SD)		86.1 (6.4)
Gender, n (%)	Male	4 (57.1)
	Female	3 (42.9)
Walking aid, n (%)	No	4 (57.1)
	Yes	3 (42.9)
Memory disorder	No	0 (0.0)
	Yes	7 (100.0)

4.2 Implementation of Functioning Measurements and Intervention

Functioning measures could have been performed on the research participants. One participant refused to do the Timed Up and Go (TUG) and Short Physical Performance Battery (SPPB) measures in pretest and posttest and one refused to do Geriatric depression Scale (GDS-15) in the posttest. All seven participants finished the eight-week intervention program without any injuries. Gaming sessions lasted from five (5) minutes to two hours with an average of 30 min and participants played games from zero to four times per week based on the logbook.

4.3 Benefits of the Intervention for the Residents

Staff experiences of benefits of the digital gaming intervention were classified into three main categories: The intervention enabled a new kind of physical activity, the intervention increased the social a0ctivity and brought residents together and the intervention brought joy and variety to the residents. The intervention was described as enabling residents to engage in new kinds of physical activities by increasing residents' physical activity and requiring different body movement from the player for example compared to walking

exercise. One resident who rarely left his room became more active and he started moving in the common areas of the LCT facility. Some of the residents liked playing games like bowling while standing, and that required weight shifting, reaching out in different directions, and picking balls from the floor. *"He surprised me by throwing balls and picking them up from the floor by himself." Interviewee 2.*

The intervention increased the social activity of the residents and brought them together, as the intervention increased the social interaction of the residents, created a connection between them, and acted as a joint activity and increased interaction. Part of the gaming sessions were held in pairs or in small groups and residents who usually do not interact with each other's played together and had a conversation. *"They started playing together and talked to each other on the side, in a way the ones that don't usually get closer to each other." Interviewee 3.* One resident often encouraged other players and became friends with others. Gaming was said to bring the residents together, which created a sense of community.

The intervention brought joy and variety to the residents, as the games delighted and increased residents' alertness and it was seen as a meaningful and varied activity. Residents had fun while playing games and one resident laughed and giggled while playing. *"…this is funny, she giggled, and she had so much fun." Interviewee 1.* One resident who never participated in activities found himself meaningful activity through gaming (Table 2).

Table 2. Qualitative analysis

Subcategory	Main category
Benefits of the intervention	
Playing increased residents' physical activity	The intervention enabled a new kind of physical activity
Playing required different body movement	
Intervention increased social interaction among residents	The intervention increased the social activity and brought residents together
Intervention created a connection between residents	
Gaming worked as a joint activity and increased interaction	
The intervention delighted and increased residents' alertness	The intervention brought joy and variety to the residents
Gaming as a meaningful and varied activity	
Success of implementing the intervention	
The staff showed little interest in the Yetitablet	Low involvement of staff in the implementation of the intervention
Few of the staff used the Yetitablet	
Residents participated in the game when requested	Active participation of the residents in the gaming sessions

(*continued*)

Table 2. (*continued*)

Subcategory	Main category
Gaming physical and mental load suitable for residents	
Residents were able to concentrate on playing well	
Game sessions can be arranged regularly	Variable success of implementing the intervention protocol in the everyday life of LTC facility
Varying success of playing while standing up	
The challenges of playing together	
Group play implementation challenging	
Filling out the game log challenging	
Factors affecting the implementation	
Staff motivation to do new things affects implementation	Positive attitude and motivation of staff important in implementation
Staff enthusiasm to try new things	
Staff struggling to adopt new technology	Staff attitude towards technology can challenge implementation
Negative attitude of staff towards learning to use new technology	
Yetitablet's easy use supported its use	Staff competence in using Yetitablet
The challenges of using Yetitablet	
Practical orientation and user support help the implementation	Practical training, clear instructions and an example of use support the implementation
Example of using a new device for staff	
The need for the clearer user instructions	
Insufficient guidance on suitable games	
Placing the Yetitablet in a separate space reduced its use	Proper placement of the device is essential to use
Choosing the type of device and placing the device in common areas would have increased use and enabled communal social events	
Residents' enthusiasm for intervention	Residents' attitude towards participating in activities
A challenge of involving some residents in activities general	
Poor memory challenged the adoption of new technology	Poor cognition as a challenge
Poor cognition challenged gaming	
Yetitablet games liked by residents	Identifying individually suitable games for residents
Lack of suitable games	
Problems with using the touch screen	Success of using the touchscreen
Residents were able to use the touchscreen successfully	

4.4 Implementation of the Intervention

Success of intervention implementation was classified into three main categories: active participation of the residents in the gaming sessions, low involvement of staff in the implementation of the intervention and variable success of implementing the intervention protocol in the everyday life of LTC facility. The interviewees felt that the staff showed little interest in Yetitablet and few of them used Yetitablet. Instructing residents how to play the games was mainly the responsibility of interns, and therefore few of the permanent staff used the Yetitablet.

The residents participated actively in the gaming sessions. They participated in the game when requested, gaming physical and mental load was suitable for residents, and they were able to concentrate on playing well. Some of the residents were always happy to play, but some had to be motivated sometimes. Watching others play encouraged participation, and some found it difficult to stop playing once they started playing.

The implementation of the intervention protocol in the everyday life of the LTC varied. Regular gaming sessions were organized but playing while standing up varied. To gain changes in physical functioning like balance and physical activity, games were supposed to be played standing up as much as possible. However, it was challenging to motivate some residents to play in a standing position and some of them usually wanted to sit down while playing. There were also challenges associated with playing together and playing as a group. To gain social and psychological changes, games were encouraged to be played together with other residents in small groups. However, some residents wanted to play alone or only with the staff member, not with another resident. Sometimes residents were insecure about their own skills while playing with another resident and they had to be encouraged to play together. Forming a group was sometimes challenging. *"It is one challenge to get them to play at the same time. One refuses, one goes to bed, one is sick. That group is sometimes hard to form." Interviewee 1.* Filling out a game log was challenging, and not all the gaming sessions were marked down.

4.5 Factors Influencing the Implementation

Factors affecting the implementation formed nine main categories: positive attitude and motivation of staff important in implementation, staff attitude towards technology can challenge implementation, staff competence in using Yetitablet, practical training, clear instructions and an example of use support the implementation, proper placement of the device is essential to use, residents' attitude towards participating in activities, poor cognition as a challenge, identifying individually suitable games for residents and successful use of the touchscreen.

In implementing the intervention, the staff must have a positive attitude and be motivated. The staff's motivation to do new things and the staff's enthusiasm to try new things affected the implementation. The staff's attitude towards technology can challenge its implementation, and the staff struggled to adopt new technology. Using the new device requires effort in the beginning, and the staff did not remember to use or put effort into using the Yetitablet. During the intervention, it was observed that the staff did not incorporate the Yetitablet into the daily activities, such as instructing stimuli activities, but instead acted as they were used to. *"Especially all such technological*

devices. Those are often more difficult to implement." Interviewee 3. Staff may have a negative attitude towards learning to use new technology. The interview revealed that staff may find learning to use technical equipment annoying and that they think they will not learn how to use it. These beliefs can prevent usage.

The staff's competence in using Yetitablet influenced its use. Easy use of Yetitablet supported its use and staff members who did not participate in the Yetitablet training were able to use it. The device was also handy to use so using it was not time consuming. On the other hand, there were some challenges in using Yetitablet. Sometimes the power button was hard to find and navigating the tablet, for example, from the game back to the home screen was challenging for some of the staff.

Practical training, clear instructions, and an example of using Yetitablet supports the implementation of the intervention. The interviewees hoped for practical orientation and user support. Training of the staff should not be too theoretical, instead, it should encourage staff to try different games themselves to lower the threshold for using Yetitablet. *"It would need a really good hands-on orientation so that people could see what they could do with it, so maybe it would be easier to approach." Interviewee 2.* The interviewees also suggested holding Teams meetings to support the use of Yetitablet during the intervention. Interviewees also needed an example of using the new device as it would have a positive impact on the attitude of the rest of the staff, as they would see an example of using the new device and its benefits for residents. There was a need for clearer instructions for using the Yetitablet, and the guidance of suitable games was insufficient. The placement of the Yetitablet in the LTC premises is essential for its use. Placing the Yetitablet in a separate space reduced its use, and the interviewees felt that choosing the type of device and placing the device in common areas would have increased use and enabled communal social events.

The residents' attitude towards participating in activities affected participation in the intervention. The residents were enthusiastic about this intervention, but it was challenging to involve some residents in activities in general. One nurse said the residents participated surprisingly well and they really liked the intervention and Yetitablet. Some residents always participated in the activities of LTC, and they also participated in this intervention happily. Some of the residents did not normally participate in the LTC activities, but they too got excited about playing on the Yeti tablet. *"Many residents who don't usually participate in anything liked it. They liked to play with it a lot. So, I think it's nice that we got something to do with them." Interviewee 3.*

The poor cognition of the residents was a challenge. Poor memory challenged the adoption of new technology and for many residents, the purpose of the Yetitablet and the instructions for the games always had to be repeated, and they could not remember what the Yetitablet was, even though they had used it before. This challenged the learning of how to use it. In addition, poor memory affected the use of the activity monitor. Many residents took it off because they couldn't remember its purpose. *"Then that monitor was taken off the wrist pretty quickly. I guess it just felt weird and they wondered what it is, and then just took it off." Interviewee 2.* A poor cognition also challenged gaming. Two residents had problems concentrating on gaming and could leave in the middle of the session. Also changes in medication, for example, caused confusion in a resident, which prevented participation in the intervention.

Identifying individually suitable games for residents affects the use of Yetitablet. The games were mostly liked by the residents and Yetitablet had interesting games for most of the residents. *"All those word games were his favorites, but he also played all the other games, even though he thought they were too easy, he still got excited about them. He wouldn't quit playing those games on his own." Interviewee 2.* For some of the residents, there was a lack of suitable games. Some residents thought the games were childish and pointless.

The success of using the touchscreen contributed to the success of the residents' gaming. There were some problems with using the touch screen, but mainly the residents were able to use the touchscreen successfully. First the use of the touch screen was new for the residents but once they learned to use it was easy. Residents learned the use individually and for some it was easy and for some learning took more time. *"In my opinion, it depended on the person (success of using the touch screen). Others were just doing really well." Interviewee 2.*

5 Discussion

This study gave information about the feasibility of the intervention and Yetitablet and preliminary information about its benefits which helps the implementation of this intervention in the future. Based on this study, it seems that intervention can have benefits especially on social functioning and social activity. A previous study of older people living independently also found that playing a digital bowling game in a group reduces loneliness and increases social connection between players [27]. Again, this study found social interaction between players during gaming and improved social relationships between players. Benefits on mood were observed in this study, and these are in line with previous research findings [28, 29]. As in this study, also in the Keogh et al. [28] study it was found that older gamers have fun playing digital games. Jahouh et al. [29] found out digital exergames generate higher positive emotions in institutionalized older players than traditional exercise what helps reduce symptoms of depression.

In an earlier digital gaming usability study, it was noticed that facilitators of new technology adoption in LTC facilities were ease of use of the technology and versatility of the technology [30]. These same factors also helped in the implementation of the Yetitablet, as the Yetitablet was considered easy to use and its content was diverse, which made it possible to find suitable games for each player. It was also possible to modify the Yetitablet for both the purpose of individual rehabilitation and group activities. However, despite the ease, the staff had a high threshold to start using the Yetitablet. This has been noticed also in previous studies implementing new gaming technology to LTC facilities. In Jbilou et al. [31] pilot study strike, staffing shortage and competing research projects limited staff engagement in using new technology. At the beginning of this intervention, the LTC facility had an intern whose training tasks included guiding game sessions on a Yetitablet. Permanent staff probably felt that implementing the intervention was not their task because of the intern, so they did not use the Yetitablet much. Staffing shortage probably did not affect this study, but it will be great risk for recruiting facilities for future effectiveness study and for implementing the intervention.

User training of Yetitablet should be more hands on in the future. Based on this experience it is important that the staff get used to using Yetitablet, they know what can

be done with it and what games work well with their residents. Jbilou et al. [31] suggested providing recurring training and information sessions for the staff and this same thing came up in this study as well. It was also challenging for the staff to find or choose suitable games for residents individually. In the future, the arrangement of applications and games on Yetitablet's home screen should be considered so that it would be easy for staff to choose suitable games for residents. Also, managers' support for the staff to implement the intervention should be better considered. It has been noticed that if health care leaders do not support implementation of new technology, it struggles to succeed [32]. It is also important to identify those staff members who have a strong interest in using the Yetitablet and implementing the intervention and who also have the ability to use new technology. Those people could support and train other staff members in the use of Yetitablet [31, 33].

During the study we noticed the Geriatric Depression Scale 15 was not suitable for this population because all the participants had severe memory disorder. Participants were unable to respond to all items consistently. Furthermore, it would be better to measure the effects of gaming on the mood before and after the game session, not before and after the intervention. The Short Physical Performance Battery was very difficult for those participants who used walking aid. Older people who already need the walker to support their movement already have balance issues and weakness in the muscles of the lower limbs so performing the balance test and chair raise test were impossible. The use of that measurement should be carefully considered in the future trial.

Although we received information about the feasibility of the intervention and the Yetitablet, some uncertainty remains. First, due to timetable issues, we were not able to test the activity monitors properly. The participants had activity monitors during the last two weeks of the intervention so we got some information about the usability of the monitors, but we could not test the data collection and reliability of the data. Commercial wearable monitors are often designed for healthy adults, and there is uncertainty about reliable measurement of activity data in older people with mobility problems [34]. Based on this trial there are challenges in the use of activity monitors if participant has a severe memory disorder, but activity data could be collected from participants with better cognitive capacity. However, the success of collecting activity data using activity monitors is uncertain.

This study has some limitations and sources of bias. First, this study was carried out only in one small long-term care facility which may limit generalizability of the intervention protocol to other facilities. The small number of participants is clearly a limitation since the literacy states that pilot trials should include about 30 participants [35]. For this reason, we did not analyze the results of the functioning measurements and thus did not obtain information on the intervention's effectiveness on functioning. Also, the number of people who used the Yetitablet and implemented the intervention in the facility was small and therefore the interview data remained limited.

6 Conclusions

Based on this feasibility study, the intervention was well received by the residents, and the staff responded positively to it. The intervention was beneficial for the residents as gaming had a positive impact on their mood, sociability, and physical activity assessed

by the staff. Yetitablet and its games were also well suited for the residents. Based on this experience, intervention is therefore feasible for LTC residents. Yetitablet was suitable for the environment, but the challenge in implementing the intervention was the success of standing play, which would specifically promote the development of physical functioning, such as balance. In the future, attention must be paid to the commitment of staff to the implementation of the intervention and to the instructions for the use of the device and games, so that the use of Yetitablet becomes a part of everyday life at LTC facilities. This study highlighted important factors related to the implementation of the intervention, which will help the successful implementation of the intervention in future effectiveness study.

Disclosure of Interests. The authors have no competing interests to declare that are relevant to the content of this article.

References

1. Sudhir, K., Sudheera, K., Demonge, K.A.: Physical activity levels among community dwelling and care home dwelling elderly population. Indian J. Physiotherapy Occupational Therapy **16**(1), 143–149 (2021). https://doi.org/10.37506/ijpot.v16i1.17787
2. Ikezoe, T., Asakawa, Y., Shima, H., Kishibuchi, K., Ichihashi, N.: Daytime physical activity patterns and physical fitness in institutionalized elderly women: An exploratory study. Arch. Gerontol. Geriatr. **57**(2), 221–225 (2013). https://doi.org/10.1016/j.archger.2013.04.004
3. Jantunen, H., Wasenius, N., Salonen, M.K., Perälä, M., Osmond, C., Kautiainen, H., et al.: Objectively measured physical activity and physical performance in old age. Age Ageing **46**(2), 232–237 (2017). https://doi.org/10.1093/ageing/afw194
4. de Oliveira, L., Souza, E.C., Rodrigues, R., Fett, C.A., Piva, A.B.: The effects of physical activity on anxiety, depression, and quality of life in elderly people living in the community. Trends Psychiatry Psychother **41**(1), 36–42 (2019). https://doi.org/10.1590/2237-6089-2017-0129
5. Wiemeyer, J., Kliem, A.: Serious games in prevention and rehabilitation—a new panacea for elderly people? Eur. Rev. Aging Phys. Act. **9**(1), 41–50 (2012). https://doi.org/10.1007/s11556-011-0093-x
6. Chu, C., Quan, A., Souter, A., Krisnagopal, A., Biss, R.: Effects of exergaming on physical and cognitive outcomes of older adults living in long-term care homes: a systematic review. Gerontology (Basel) **68**(9), 1044–1060 (2022). https://doi.org/10.1159/000521832
7. Taylor, L.M., Kerse, N., Frakking, T., Maddison, R.: Active video games for improving physical performance measures in older people: a meta-analysis. J. Geriatric Phys. Therapy **41**(2), 108–123 (2018). https://doi.org/10.1519/JPT.0000000000000078
8. Martinho, D., Carneiro, J., Corchado, J.M., Marreiros, G.: A systematic review of gamification techniques applied to elderly care. Artif. Intell. Rev. **53**(7), 4863–4901 (2020). https://doi.org/10.1007/s10462-020-09809-6
9. Li, J., Erdt, M., Chen, L., Cao, Y., Lee, S., Theng, Y.: The social effects of exergames on older adults: systematic review and metric analysis. J. Med. Internet Res. **20**(6), e10486 (2018). https://doi.org/10.2196/10486
10. Saragih, I.D., Everard, G., Lee, B.: A systematic review and meta-analysis of randomized controlled trials on the effect of serious games on people with dementia. Ageing Res. Rev. **82**, 101740 (2022). https://doi.org/10.1016/j.arr.2022.101740

11. Jarva, E., et al.: Healthcare professionals' perceptions of digital health competence: a qualitative descriptive study. Nurs. Open **9**(2), 1379–1393 (2022). https://doi.org/10.1002/nop2.1184
12. Nilsen, E.R., Dugstad, J., Eide, H., Gullslett, M.K., Eide, T.: Exploring resistance to implementation of welfare technology in municipal healthcare services – a longitudinal case study. BMC Health Serv. Res. **16**, 657 (2016). https://doi.org/10.1186/s12913-016-1913-5
13. Kukkohovi, S., Siira, H., Arolaakso, S., Miettunen, J., Elo, S.: The effectiveness of digital gaming on the functioning and activity of older people living in long-term care facilities: a systematic review and meta-analysis. Aging Clin. Exp. Res. **35**(8), 1595–1608 (2023). https://doi.org/10.1007/s40520-023-02459-y
14. Swinnen, N., et al.: The efficacy of exergaming in people with major neurocognitive disorder residing in long-term care facilities: a pilot randomized controlled trial. Alzheimer's Res. Therapy **13**(1), 70 (2021). https://doi.org/10.1186/s13195-021-00806-7
15. Delbroek, T., Vermeylen, W., Spildooren, J.: The effect of cognitive-motor dual task training with the biorescue force platform on cognition, balance and dual task performance in institutionalized older adults: a randomized controlled trial. J. Phys. Ther. Sci. **29**(7), 1137–1143 (2017). https://doi.org/10.1589/jpts.29.1137
16. Soares, A.V., Borges, N.G., Hounsell, M., Marcelino, E., Rossito, G.M., Sagawa, Y.: A serious game developed for physical rehabilitation of frail elderly. Neurophysiol. Clin. **46**(4), 281 (2016). https://doi.org/10.1016/j.neucli.2016.09.109
17. Va´zquez, F.L., Otero, P., Garcı´a-Casal, J.A., Blanco, V., Torres, A.J., Arrojo, M.: Efficacy of video game-based interventions for active aging. A systematic literature review and meta-analysis. PLoS ONE **13**(12), e0208192 (2018). https://doi.org/10.1371/journal.pone.0208192
18. Yeticare homepage. https://yeticare.fi/fi/. Accessed 05 Jun 2023
19. Kallio, H., Pietilä, A., Johnson, M., Kangasniemi, M.: Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. J. Adv. Nurs. **72**(12), 2954–2965 (2016). https://doi.org/10.1111/jan.13031
20. Yang, H., Yoo, Y.: It's all about attitude: revisiting the technology acceptance model. Decis. Support. Syst. **38**, 19–31 (2004). https://doi.org/10.1016/S0167-9236(03)00062-9
21. World Health Organization (WHO). International Classification of Functioning, Disability and Health: ICF. https://iris.who.int/bitstream/handle/10665/42407/9241545429.pdf?sequence=1 (2001)
22. Guralnik, J.M., Simonsick, E.M., Ferrucci, L., Glynn, R.J., Berkman, L.F., Blazer, D.G., et al.: A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. J. Gerontol. **49**(2), 85–94 (1994). https://doi.org/10.1093/geronj/49.2.m85
23. Podsiadlo, D., Richardson, S.: The Timed "Up & Go": a test of basic functional mobility for frail elderly persons. J. Am. Geriatr. Soc. **39**(2), 142–148 (1991). https://doi.org/10.1111/j.1532-5415.1991.tb01616.x
24. Kurlowicz, L., Greenberg, S.A.: The geriatric depression scale (GDS). Am. J. Nurs. **107**(10), 67–68 (2007). https://doi.org/10.1097/01.NAJ.0000292207.37066.2f
25. Gerritsen, D.L., Steverink, N., Frijters, D.H.M., Hirdes, J.P., Ooms, M.E., Ribbe, M.W.: A revised index for social engagement for long-term care. J. Gerontol. Nurs. **34**(4), 40–48 (2008). https://doi.org/10.3928/00989134-20080401-04
26. Elo, S., Kyngäs, H.: The qualitative content analysis process. J. Adv. Nurs. **62**(1), 107–115 (2008). https://doi.org/10.1111/j.1365-2648.2007.04569.x
27. Schell, R., Hausknecht, S., Zhang, F., Kaufman, D.: Social benefits of playing Wii bowling for older adults. Games Culture **11**(1–2), 81–103 (2016). https://doi.org/10.1177/1555412015607313

28. Keogh, J.W.L., Power, N., Wooller, L., Lucas, P., Whatman, C.: Physical and psychosocial function in residential aged-care elders: effect of Nintendo Wii sports games. J. Aging Phys. Act. **22**(2), 235–244 (2014). https://doi.org/10.1123/japa.2012-0272
29. Jahouh, M., González-Bernal, J., González-Santos, J., Fernández-Lázaro, D., Soto-Cámara, R., Mielgo-Ayuso, J.: Impact of an intervention with wii video games on the autonomy of activities of daily living and psychological-cognitive components in the institutionalized elderly. Int. J. Environ. Res. Public Health **18**(4), 1570 (2021). https://doi.org/10.3390/ijerph18041570
30. Chu, C., Biss, R., Cooper, L., Quan, A., Mantulis., H.: Exergaming platform for older adults residing in long-term care homes: user-centered design, development, and usability study. JMIR Serious Games **9**(1), e22370 (2021) https://doi.org/10.2196/22370
31. Jbilou, J., El Bouazaoui, A., Zhang, B., Henry, J., McDonald, L., Hall, T. et al.: Evaluating and motivating activation in long term care: lessons from a pilot study. In: International Symposium of Human Factors and Ergonomics in Healthcare 2021, vol. **10**(1), pp. 42–46. Sage (2021). https://doi.org/10.1177/2327857921101016
32. Laukka, E., Huhtakangas, M., Heponiemi, T., Kanste, O.: Identifying the roles of healthcare leaders in hit implementation: a scoping review of the quantitative and qualitative evidence. Int. J. Environ. Res. Public Health **17**(8), 2865 (2020). https://doi.org/10.3390/ijerph17082865
33. Dugstad, J., Eide, T., Nilsen, E.R., Eide, H.: Towards successful digital transformation through co-creation: a longitudinal study of a four-year implementation of digital monitoring technology in residential care for persons with dementia. BMC Health Serv. Res. **19**(1), 366 (2019). https://doi.org/10.1186/s12913-019-4191-1
34. Teixeira, E., Fonseca, H., Diniz-Sousa, F., Veras, L., Boppre, G., Oliveira, J., et al.: Wearable devices for physical activity and healthcare monitoring in elderly people: a critical review. Geriatrics (Basel) **6**(2), 38 (2021). https://doi.org/10.3390/geriatrics6020038
35. Lewis, M., Bromley, K., Sutton, C.J., McCray, G., Myers, H.L., Lancaster, G.A.: Determining sample size for progression criteria for pragmatic pilot RCTs: the hypothesis test strikes back. Pilot Feasibility Stud. **7**(1), 40 (2021). https://doi.org/10.1186/s40814-021-00770-x