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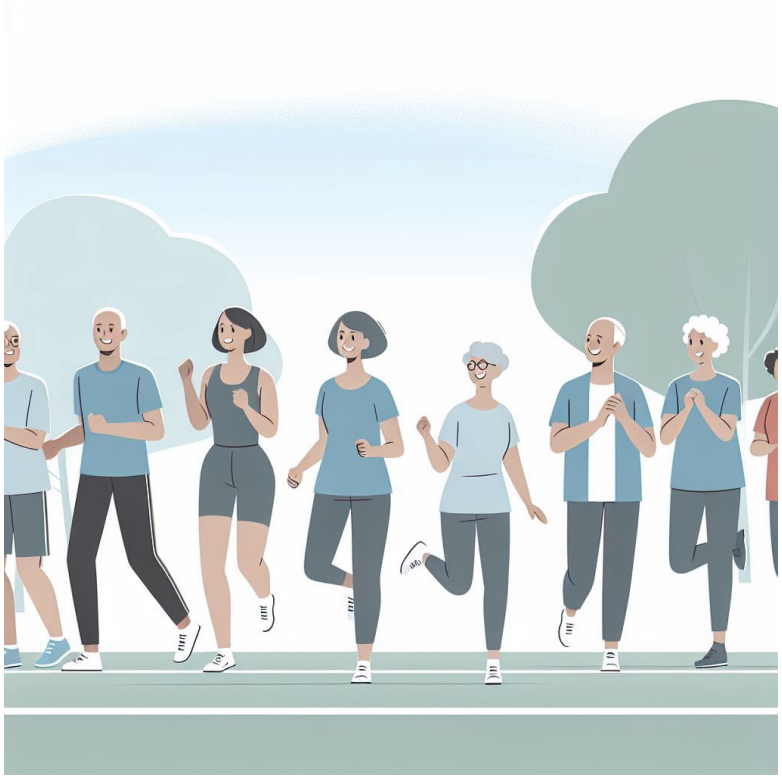
EUAPPTIVE

EUAPPTIVE PROJECT
Guidelines for Urban PA promotion



Guidelines for Urban PA promotion

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Introduction

As the global population ages, promoting physical activity among older adults has become a public health priority [1]. Regular physical activity is recognized as one o the most potent non pharmaceutical treatment essential for maintaining health, mobility, and independence in older adults. Yet many older adults face barriers such as physical limitations, lack of motivation, and limited access to exercise resources [2]. Digital interventions, including mobile health applications, wearable fitness trackers, and online exercise programs, offer promising solutions by passing some of these challenges (e.g. distance to exercise facilities) and by providing personalized feedback, convenient access to exercise resources, and in some cases a social network [3, 4]. They have also represented one of the most important intervention types during the COVID-19 pandemic period [5]. However, digital interventions are challenged by digital literacy and willingness to join these programs.

This document is part of the EUAPPTIVE project, a European Commission-funded initiative aimed at increasing physical activity among community-dwelling older adults through digital interventions. The purpose of this document is to gather comprehensive information on the barriers and facilitators to engaging in digital interventions, which is crucial for planning and implementing effective strategies.

To achieve this, we conducted an app market review, a scoping umbrella review of systematic reviews, and focus groups in Denmark, Portugal, and Spain. The app market review identifies successful digital tools and programs that promote physical activity, highlighting their features and adaptations for older adults. The umbrella review synthesizes evidence on the barriers and facilitators to engaging in digital interventions, providing a broad understanding of the factors influencing their adoption and effectiveness. The focus groups offer valuable perspectives from older adults themselves, revealing their needs, preferences, and challenges related to digital health tools.

By integrating findings from these diverse sources, this document aims to provide a comprehensive view of how digital interventions may be optimized to support physical activity in older adults. The insights gained will inform the development and implementation of the EUAPPTIVE project, ultimately enhancing the health and well-being of this growing population.

Section 1 – FOCUS GROUPS

Title

Barriers and facilitators to promote PA digital interventions for community-dwelling older adults

This document provides the thematic analysis of three focus groups carried out by Danish, Portuguese and Spanish municipality with focus on identifying potential barriers and facilitators to design a digital intervention

The focus group support the design of the app by identifying which potential challenges we may expect in relation to the digital component of the intervention. The older participants may be ready to initiate a conventional face to face physical activity intervention, but they may be "unprepared" or uninterested for an intervention which builds on digital tools and demands some digital skills. The success of the EUAPPTIVE (European Active Ageing Challenge) intervention depends thereby not only on the motivation to engage in a physical active behavior but also to bypass potential barriers related to the use of digital tools.

The focus group methodology will thereby help the developers of the app to identify critical issues when designing the app based on the direct voice of older adults who represent the typical older citizen who will be enrolled for the EUAPPTIVE intervention. At this aim, considering different levels of digital skills, previous and current experience with the digital environment and cultural attitude, three focus groups representing the different countries of the project were conducted.

Objective

The goal of the focus groups was to identify needs, potential barriers and facilitators regarding the development of an app aimed at increasing physical activity through a digital intervention targeting community-dwelling older adults. The focus groups We have therefore concentrated on the barriers and facilitators this population may encounter in a project like EUAPPTIVE.

Methods

Three focus groups were conducted in Denmark, Portugal, and Spain. Each focus group was organized by the respective partner responsible for that region with a convenience sample of 5 to 8 participants locally recruited. The recruitment process was managed by the local partners.

Guidelines for focus groups

The guidelines related to the implementation of focus groups were provided by the Danish partner, the University of Southern Denmark (SDU). In details, it was recommended that participants in the focus group should be community dwelling older citizens possibly with different age groups (minimum age 65 years, older and very adults (65-75; 75-85 years old), females and males, with various degrees of digital skills. It was also recommended enrolling participants with different level of weekly physical activity (e.g. none, sporadic, some) and to have 5 to 8 participants per group. Additionally, it was recommended that participants recruited in the focus group should have a *"similar profile (e.g. digital skills, physical activity level)"* to the participants targeted for the EUAPPTIVE intervention to ensure a representative sample.

Finally, it was recommended to use recruitment pathways similar to the pathways planned for the EUAPPTIVE intervention. These may include i) healthcare & service providers (e.g. preventive home visits in Denmark); ii) parishes; iii) existing older adults fitness groups. Ideally, the person who invited the participant (e.g. doctor/nurse) was aware of the physical activity level of the participant. A copy of the interview text provided is available in **Appendix**.

An example of invitation letter was provided (see **Box 1**).

Box 1 *– Sample of invitation letter for the focus group*

Dear (Name),

I am writing to extend a heartfelt invitation to you to participate in a focus group discussion aimed at shaping a new initiative designed for elder adults within our municipality. A focus group is an informal conversation where you, other 4-7 persons, and a moderator will discuss experiences and ideas. As a valued member of our community, your insights and perspective are crucial in making this initiative a success.

The focus group will convene on (Date) at (Time) at (Location).

During this session, we will discuss the main barriers and facilitators to increase physical activity through a smartphone app in older adults. Your participation and your opinion in this discussion are highly relevant and can significantly influence the development of this project.

Your expertise, experience and opinions are highly regarded, and we would be honored to have you join us for this important dialogue. (Name and role) and (Name and role) will welcome you and guide the discussion. Coffee/tea and cookies will be provided. None of your opinions or personal information will be disclosed or used for marketing: it will be only used for ongoing scientific research that is being carried out in the context of the European Project EUAPPTIVE. You can find more information about the project at https://euapptive.eu/

Please confirm your attendance by (Date) by contacting (Name) at (Phone number and e-mail).

Thank you for your commitment to our community, and I look forward to your participation in this important discussion.

Warm regards,

Data collection

Basic characteristics of the participants in the focus groups included age, sex, level of digital skills (e.g. 0-10 scale, type of digital daily usage), and previous experience with physical activity (e.g. number of years, type of physical activity, current/former, type of physical activity).

Focus groups were audio-recorded and transcribed at a later stage. During the focus group ideas were mind-mapped by the main moderator while one/two additional moderators took notes during the focus group to identify the key themes highlighted by the participants. Before concluding the focus group, main ideas were summarized with the participants and eventually adjusted accordingly.

The recording of the focus was transcribed in the original language and translated in English (using AI tools, such as Deepl or chat GPT) and edited by mother tongue persons, if needed. Preliminary analysis of the focus group was carried out by the interviewer by noting “key themes” that emerged during the focus group.

Data analysis

After the focus groups were implemented, anonymized transcripts translated in English were sent to SDU for the thematic summary. Thematic analysis was carried out utilizing the Framework method as described by Gale (2013) [6]. The method used involved a deductive approach to coding, with predefined codes based on the specific questions posed during the focus group discussions.

After familiarization with data and initial coding, key elements were summarized in a matrix (**Table 1.1**, **Table 1.2** and **Table 1.3**), which consisted of rows (participants) and columns (codes). To analyze the summarized data, themes and patterns were identified. Selected quotes from the participants are provided for each focus group.

Table 1.1: Framework Matrix – focus group (Denmark)

Danish Participants (sex, age)	Physical activity	Health barriers	Health motivators	Digital literacy and device use	Technology barriers	Technology facilitators
Participant 1 (m, 85)	Interval training (treadmill), walking	Shoulder injury (prevented tennis)	Enjoys feeling good after exercise → enjoyment, physical benefit	Low/medium	Struggles with apps, difficulty keeping up with technology	Uses iPad to read newspaper when physical copy unavailable
Participant 2 (f, 80)	Gymnastics, walking, fitness, home exercises (for back pain)	Back pain	Motivation comes from the need to stay fit after husband's death and back pain. Adventure experience and travelling. → Family; → pain	Medium	Prefers using the computer for transactions over an iPad	Uses computer for daily tasks (banking, travel bookings). ”Competition” with daughter on language app.
Participant 3 (f, 80)	Strength training, fitness, golf, swimming (in summer)	None stated	Competitive spirit, prefers structured routines → healthy routine and personality	Medium/high	None stated	Uses technology for researching health and nutrition, especially for fitness and diet. Curiosity and competitive spirit.
Participant 4 (m, 82)	Golf (2x/week), fitness in winter, walking, cycling	None stated	Wants to live longer to enjoy time with grown children and grandchild → healthy routine, family life	Medium/high	Prefers simplicity in technology, finds complex features overwhelming. Finds the competitive aspect	Uses phone to track stock prices, reads tickets via phone.Believes an exercise app should be

					of some apps unnecessary, prefers tech that is simple and straightforward	accessible (inclusive) (low costs)
Participant 5 (f, 86)	Gymnastics, Strong Legs program, walking	Hip replacement, cannot cycle or play golf anymore	Motivation to stay active despite physical limitations. → Dog role. → Having a garden to take care of. → Stairs.	Medium	Struggles with some settings, prefers printed tickets over mobile. Believes an exercise app needs to be flawless, or it will not work.	Uses iPad for Sudoku, reading and printing tickets, appreciates practical help with tech issues.
Participant 6 (m, 82)	Fitness center (cycling, treadmill), violin building (hand exercises)	None stated	Stays active by engaging in hobbies like violin building, motivated to stay mentally active through writing →	High	None stated	Controls hearing aids via smartphone, writes a life story on the computer

Denmark - Summary of key themes

1. **Previous experience with physical activity/exercise/sports programs and other forms of leisure physical activity**:

   Most participants are engaged in some form of structured or unstructured physical activity, with many engaging in fitness, gymnastics or sports like golf. Walking with a dog and gardening are often reported as relevant activities.

Quote:

"I'd like to say that one thing for older people, which is incredibly important, is balance. You train a lot of balance" (Participant 3)

2. **Health barriers:**

   This category aims at identifying potential health barrier which may prevent older adults to engage in traditional or digital physical activity programs.

   Some participants face physical challenges which limit their mobility such as hip replacement and back pain, but they reported to remain motivated to stay active. The physical challenge is often a reason more to stay active (motivator).

3. **Health facilitators/motivators**:
   three main domains were identified:
   - **Role:** i) role within the family, ii) role with pets
   - **Independency:** living as long as possible at home
   - **Health management:** health goals, like reduce/ manage pain; improve/maintain a certain physical condition

Quotes:

"We've invested in a dog, which we are getting in a week. So now we'll have to walk a lot and, well, the dog will need to go out" (Participant 4)

"And what motivates me now is that I want to live longer and enjoy my kids" (Participant 4)

"We had some small children who didn't speak. And we used a lot of motor skills training with them. And that was training for us too, who worked with them. So, I got a lot of training." (Participant 5)

Participants are motivated by the desire to maintain independence, reduce/manage pain and/or increase mobility, or enjoy life with family. Animals (e.g. dogs) are a motivation to stay active.

4. **Technology use**:
   Two main domains were identified:
   - **Leisure:** use of technology for curiosity (search info, play games, learn languages); reading; theater/travel tickets, etc.
   - **Needs:** use of technology for daily needs (e.g. bank, doctors, manage hearing aids)

5. **Technology Barriers**: Many participants find certain technological features difficult to use or prefer traditional methods like printed tickets over digital.

   Three main domains were identified:

   - **Complexity:** complexity of digital tools is one of the major barriers.
   - **Lack of flawlessness**
   - **Social inequality:** it was reported that social inequality may be a challenge for partipants with different level of knowledge and additional aspects

Quotes:

"*When you're making something that's going out to everyone, it has to be flawless […] It has to be super professional […] or you don't want to use it anymore*" (Participant 5)

"I think it would be useful to have it with a tool that is manageable. For me, a phone is too small, and I can't carry around a computer. So it's either a PC or an iPad-like, a tablet for me, that can be carried around" (Participant 4)

"[Regarding the accessibility of the app] … there shouldn't be any social inequality" (Participant 4)

6. **Technology Facilitators**:

   Several domains were reported for this category:

   - **Daily support (in presence/remote) and technical assistance:** the presence of family members/friends who provide technical support, or availability of affordable services that offer technical assistance (e.g. in senior centers, or family members) are very important facilitators.
   - **Simplicity:** similar to the technological barriers, it was highlighted that simplicity is one of the most important aspects for the interface with end-users to keep in mind when developing Apps.
   - **Instructions:** easy instructions that are easy to find
   - **Size, volume and transportability**: Size of the device and transportability
   - **Helpful role:** e.g. an app reminding older adults to drink water (example made by participant 3)

Quotes:

"It should be easy for me to press some buttons, and then that's it. It shouldn't be something where I have to juggle" (Participant 1)

"*All things take time to learn*" (Participant 4)

Attitudes towards a potential EUAPPTIVE app

Participants have joined studies related to physical activity before, and were positive regarding taking part in this initiative. However, they all have different ideas based on personal differences.

Quotes:

"*So I'm thinking more about how it could be done collectively. Not a competition, but a community. In some way*". (Participant 2)

"[A competition] it wouldn't mean anything at all to me. What motivates me is how I get better through it. And not to compete with Amsterdam […] I am not like my wife, she is a competitive person" (Participant 4)

Table 1.2: Framework Matrix – focus group (Portugal)

Portuguese Participants (sex, age)	Physical activity	Health barriers	Health motivators	Digital literacy and device use	Technology barriers	Technology facilitators
Participant 1 (F, 79)	Gardening, Gym (2x/week)	Not mentioned	Enjoys gardening and gym activities → enjoyment	High. Uses every day mobile devices independently	Not mentioned	Frequent use of communication apps (Facebook, Messenger)
Participant 2 (F, 63)	Walking (daily), Gym (2x/week)	Not mentioned	Consistency in walking, social engagement through gym → healthy routine and social engagement	Moderate. Uses devices sometimes. Uses step-counting apps, bank apps, supermarket apps, comfortable with technology	Cautious about security/privacy issues. Needs help with new tech challenges.	Daily routine tasks that are easier with technology
Participant 3 (F, 64)	Walking (not regularly), Gym, Home exercises	Not mentioned	Motivated by regular gym and home fitness activities → healthy routine	Moderate. Uses daily. Uses Messenger, Facebook for communication. Has one app only (minimal app usage)	Prefers minimal device usage; limits time on devices	Communication
Participant 4 (F, 76)	Gardening, Walking, Gym (2x/week)	Not mentioned	Enjoys gardening, gym, and outdoor activities → enjoyment, outdoor, (well-being feeling)	Very low. No use of digital device. No smartphone (only basic phone). Tablet broken;	Do not have functioning devices (lack of interest? Finance?)	Not mentioned

				currently no use of apps		
Participant 5 (F, 77)	Gym (home), Pedaling (20 min/day), Walking	Leg issues, limited mobility	Motivated to stay active despite leg issues, enjoys monitoring progress → internal motivators and progress monitoring	Moderate. Uses daily. Uses Messenger, Facebook daily. Uses little else (e.g. bank app)	Not mentioned	Communication and daily routine tasks
Participant 6 (M, 75)	Walking (2 km/day), Gardening, Gym	Tiredness, lack of stamina	Motivated by routines, enjoys physical activity → healthy routing and enjoyment	Low. Owns smartphone, but limited use (has Facebook but does not use it) – lack pf patience with mobile phones or computers.	Needs tech related assistance.	Uses Facebook for communication. Relies on wife for tech help → tech help

Portugal - Summary of key themes

1. **Previous experience with physical activity programs and other forms of physical activity**:

Participants are physically active and/or have a high level of experience. Most participants engage in a mix of structured physical activity (e.g., gym) and unstructured activities (gardening, gym at home, walking). Walking and gym sessions are the most common forms of exercise, and many participants report exercising multiple times a week. Travelling was also mentioned as an activity.

2. **Health barriers**

Some participants experience **physical limitations** such as “leg issues” or tiredness, which affect their ability to fully engage in physical activity.

3. **Health facilitators/motivators**

   Three main domains were identified:

   - **Social aspect:** participants are motivated by both by the social aspect of certain activities.
   - **Health management:** personal health goals, such as maintaining physical fitness, managing health, or staying consistent with routines.
   - **Enjoyment:** Gardening, walking, and the gym are favored activities due to their accessibility and personal enjoyment.

4. **Technology use**: there is a large **variability** in terms of technology use and digital literacy in the group. Some do not have any device like smartphone or tablet, some use them daily with confidence.
   Two main domains were identified:
   - **Needs**: daily needs (e.g. banking apps to manage finances).
   - **Leisure**: *communication* (many participants use apps such as WhatsApp and Facebook Messenger to communicate); *tracking physical activity* (use of step-counting apps)

Quotes:

“I have everything from the pharmacy, everything from the doctor, and when I need something... I have everything on my mobile phone.” (PARTICIPANT 1)
"I use the messenger more, I only have one app, which is from the bank. And because I don't like to sit and look at my iPad for too long either... I use the bare minimum." (PARTICIPANT 3)
“I don't have any apps either because, as I don't have a smartphone, I only have a mobile phone and I receive messages when there are appointments.” (PARTICIPANT 4)

5. **Technology Barriers**

   Three main domains were identified:

- **Privacy concerns**: Participants expressed concerns regarding the use of applications for the intervention, particularly related to privacy, and familiarity with technology. Some were hesitant about using mobile apps due to privacy worries, while others felt comfortable as long as they had control over what data they shared. The need for assistance and support in using these apps was also highlighted.
- **Device access and use of App**: some participants do not own smartphones or have broken devices, limiting their engagement with health and fitness apps.
- **Internet access / mobile data** was a major concern. Some participants suggested that the application should work offline to mitigate these issues.

Quotes:

“I don't really like having people, lots of people in my group, in my things. I don't like it because, you know, there are curious people.” (PARTICIPANT 1)
“I only accept what I want [regarding security issues].” (PARTICIPANT 2)
“If we don't have anyone to help, we're also afraid to do it.” (PARTICIPANT 4)
"Yes, with help it's always better, in every aspect […] I just want help so that they can then apply. Because I can't do that." (PARTICIPANT 2)
"For me, the only difficulty I find at this point is not having the internet, not having enough mobile data to make it to the end of the month." (PARTICIPANT 2)
"Well, for me it's also the limitation of mobile data. That's for sure." (PARTICIPANT 3)

6. **Technology Facilitators**

Two main domains were identified:

- **Tech-related assistance**. Several participants indicated that they would be willing to learn about a new app, but they would need assistance. This was a recurring theme, with participants acknowledging their lack of familiarity with such technology.
- **Simplicity/accessibility.**

Attitudes towards a potential EUAPPTIVE app

Participants showed enthusiasm for an intervention that **promotes healthy lifestyles through competition between European cities**. Many found the idea of tracking and comparing physical activity levels across different locations exciting and motivating. They believed it could encourage increased

physical activity and foster a **healthy competitive spirit**. Some participants noted that the competitive element could drive motivation, while others saw it as a fun way to stay engaged with their activity levels. There was a general consensus on the need for the app to remain **user-friendly** and **accessible**, particularly for older adults.

Quotes:

"It would indeed be interesting to see activity levels across various countries." (Participant 4)

"Having a device to track steps is motivating, and seeing how we compare with others could be exciting." (Participant 5)

Table 1.3: Framework Matrix – focus group (Spain)

Spanish Participants (sex, age)	Physical activity	Health barriers	Health motivators	Digital literacy and device use	Techonology barriers	Technology facilitators
Participant 1 (f, 70)	Walking (2 days/week), Yoga	Occasional laziness	Group activities and scheduled routines	Regular use of smartphone. Uses for information, and for social media.	Not mentioned	Uses apps and social media for information gathering
Participant 2 (f, 68)	Daily walking (1-1.5 hours), Beach swimming	Herniated disc, limited mobility	Recovery from hernia, enjoyment of beach activities	Uses sometimes. Use for social media and searching for information and ne	Finds spending too much time on the phone unproductive	Uses phone for general information and news
Participant 3 (f, 76)	Daily walking, group trips. (Loves travelling).	Previous wrist fracture from a fall	Enjoys travel and social activities, association participation	Regular use of smartphone and tablet. Has a stop time at night.	Avoids using the phone after 10 PM	Uses phone and tablet for coordination with associations
Participant 4 (f, 74)	Walking, swimming (2x/week), Tai Chi	Not mentioned	Starts Tai Chi, motivated by maintaining health	Uses sometimes. Uses for social media and call.	Limited phone usage	Uses WhatsApp and Facebook for communication
Participant 5 (f, 69)	Daily walking (1 hour), Zumba, ballroom dancing	Not mentioned	Enjoys dancing with her husband, motivated by social engagement	Regular use (both smartphone and tablet), mostly for instant messaging.	Overuse of phone, feels “addicted”, prefers other	Uses WhatsApp.

					priorities (e.g. reading books)	
Participant 6 (f, 67)	Walking, Zumba, Pilates, Hiking. (Loves travelling)	Herniated cervical disc, some physical limitations	Pilates as a life-saving activity, motivated by competition	Regular use, mostly for messaging and listening to podcasts.	Prefers using fewer social media platforms (hates Facebook and Tik Tok)	Enjoys listening to podcasts and uses apps for practical purposes. Regularly communicates with WhatsApp.
Participant 7 (f, 70)	Swimming (in summer), Pilates, previously Tai Chi	Spinal issues, post-surgery recovery	Motivated by physical improvement post-treatment	Regular use. Feels confident.	Not mentioned	Enjoys YouTube walking videos, uses Google Maps for navigation
Participant 8 (f, 70)	Walking w/dog 3x/day. (Before, used to do dance, aqua fitness, guided fitness classes and other sport)			Regular use, both smartphone and tablet. Uses for games and information.	Does not want Tik Tok and Instagram.	

Spain - Summary of key themes

1. **Physical Activity**

Participants are very active and engage in a variety of activities, including walking, swimming, Pilates, and Zumba. Dance, in particular, appears to be a strong motivator.

2. **Health barriers**

Some participants face **physical limitations** such as herniated discs, back pain, or spinal issues, which influence their ability to perform certain exercises.

3. **Health Facilitators/Motivators**

Three domains were identified:

- **Social engagement and enjoyment**
- **Health management**: having personal health goals, like recovery from illness or injury,
- **Independence**: the desire to maintain physical independence is a significant motivator

4. **Technology use**

- **Leisure**
    - *Communication* (many participants the smart phone with **social media**/instant **messaging** (**communication**)
    - *Information (e.g. news), podcast, video*
    - *Gaming*

Most participants used smartphones or tablets often. Some of the participants expressed willingness to use their phone less than they do, although they were confident that they had skills to use their smartphone/tablet for their preferred use.

There were concerns about certain social medias and addictive apps and platforms.

Quotes

"I should use it less. And I have a lot of applications, the least I have are social networks because I hate Facebook, I don't like it, I don't like TikTok, I use WhatsApp because obviously we communicate via WhatsApp... But I do have a lot of applications, especially a lot of podcasts, a lot, I love to listen to all of them. (PARTICIPANT 6).

I use it a lot more than I should, but well, I also forgive myself […] I use it for things that I like on a daily basis, and I don't go into social networks for gossip and so on, I don't like them, I hate them. So I don't go on those comments. I have games that I play at night when I'm watching TV and I don't

like it and so on, I have a tablet and I have those colorful games, those little ball games, I don't know, the old Candy [Crush], where you pass a level every week, crossword puzzles... And I entertain myself with that. What I don't want is Instagram, TikTok and that. (PARTICIPANT 8).

5. **Technology Barriers**

We identified 4 main domains:

- **Fear of addiction to devices**
- **Privacy / security concerns**
- **Lack of digital skills**
- **Lack of interest**

Quotes:

"Because she says that she doesn't want the phone because she feels watched, that she doesn't need any application or anything, but that person is a competitive person, she is very competitive." (PARTICIPANT 6).

"An application from 80 years old onwards is very difficult for them to catch it if it is not very slow and with functioning, with movement" (PARTICIPANT 2)

6. **Technology Facilitators**

Two domains were highlighted:

- **Tech-related assistance**: The main facilitator for use of the app that was identified by participants is assistance by personnel of elderly care centres, and to have the information of the app or the challenge in paper for those that do not possess the digital skills or digital devices.
- **Simplicity/accessibility.**

Quotes:

"*Well, for people who don't use mobile phones, this can be put in the senior centres, on paper. They won't use the application, but they can get in another way. […] And also for people who are not here but who can participate or who do download applications, so informing in senior centres." (PARTICIPANT 6)*

Attitudes towards a potential EUAPPTIVE app

Participants expressed interest in the intervention, although there were **varying opinions on the topic of competition**. Some of the participants were excited to compete, others were more interested in having a motivation to become more active. Some were more motivated simply by the physical activity. They continued to express the need for it to be **simple** so that it is accessible, concerned particularly with **accessibility for people older than 80.**

Quotes

"Well, it depends, if it's doing races, I don't like it, but if it motivates us, then yes (PARTICIPANT 1).

"Well, it's interesting, anything that encourages people and motivates you, the main thing is that it's simple. Because otherwise it's super complicated for people, of course, people in their 80s and 90s come up and the phone is out, they don't know how to use it or apply it" (PARTICIPANT 2).

"One thing I tell you, we are competing and I take all the steps I have to take, I'm up all night." (PARTICIPANT 3)

Results

Physical Activity

The thematic analysis revealed several significant barriers to physical activity among community-dwelling older adults. Physical limitations were a primary concern, with health issues such as back problems, leg issues, fatigue, and mobility restrictions frequently mentioned. These physical challenges not only hindered participation in physical activities but also instilled a fear of injury or exacerbating existing conditions, further limiting engagement. Regardless, these challenges may be similar to traditional exercise program.

Despite these barriers, several motivators for physical activity were identified:

i. Health maintenance was a significant motivator, with many participants expressing a desire to maintain or improve their health, prevent further injury, and reduce the impact of existing conditions. The motivation to stay fit and active to enjoy life with family and maintain independence was a powerful driver for many.
ii. Social interaction also played a crucial role in motivating physical activity. Group activities and structured exercise in social settings were particularly appealing, as they provided opportunities for social engagement and enjoyment. Activities such as walking, gym classes, and dancing were popular because they combined physical exercise with social interaction. Leisure activities such as gardening are often reported indicating these group of unstructured physical activities important for this population (see below as well).
iii. Routine and enjoyment were additional motivators. Keeping a regular routine helped participants stay motivated, and many reported enjoying physical activities such as gardening, walking, and gym exercises. The pleasure derived from these activities encouraged continued participation.

Technology

Technical challenges also emerged as a substantial barrier. Many participants reported concerns related to the use of apps, often due to a lack of internet access or mobile data. Additionally, low digital literacy and discomfort with complex technology features made it challenging for some older adults to adopt digital tools for physical activity.

When considering interventions through an app, several barriers were identified. Technical barriers were prominent, with many participants lacking familiarity with digital tools and feeling uncomfortable using apps. Concerns about privacy and feeling observed further deterred some older adults from potentially engaging in digital interventions.

Device access was another significant barrier. Despite a mobile phone is commonly used also in the older population, some participants did not own smartphones or had outdated devices, limiting their ability to engage with health and fitness apps. Additionally, many older adults constantly relied on family members for tech-related assistance.

The complexity and overwhelming nature of some apps also posed a barrier. Participants often perceived apps as “too complex or overwhelming”, with too many features that made them difficult to use. The

preference for traditional methods over digital solutions further hindered the adoption of app-based interventions.

Conversely, several motivators for intervention through an app were identified. These included:

i. Convenience and practicality: these two components were key motivators, as apps that simplified tasks like communication, managing finances, and tracking health metrics were highly valued. Participants expressed satisfaction from using apps for practical purposes such as step counting and health monitoring.
ii. Communication was another important motivator: staying connected with family and friends through communication apps like Messenger and WhatsApp was highly appreciated. Social features that allowed sharing progress and participating in group challenges were particularly motivating.
iii. Independence and a sense of achievement: many participants valued the independence gained from being able to perform tasks and monitor their health without needing help. The competitive spirit and sense of achievement from tracking fitness goals and progress further encouraged the use of digital tools.

Motivation

While the participants in the focus group were generally motivated to engage in physical activity, they acknowledged that motivation levels could vary widely among their peers. A lack of motivation to "learn a new skill" was highlighted as an additional barrier to engaging with digital tools for physical activity. Some participants noted occasional laziness or a lack of interest in competitive forms of activity, preferring instead more familiar, traditional methods. This inclination was often accompanied by a reluctance to adopt new technologies, further limiting their willingness to explore physical activities through digital platforms. For some, the challenge was less about interest in physical activity itself and more about the perceived difficulty of developing the digital skills necessary to participate in these newer, tech-based formats.

Suitable app features for community-dwelling older adults

To effectively promote physical activity among community-dwelling older adults, interventions should take into account different levels of fitness. A relatively simple assessment to identify the level of fitness of the participant may be needed to tailor the app-specific activities (e.g. type and intensity) and sustain the motivation by providing regular feedback on improvements to the participant. A EUAPPTIVE app should be user friendly. These apps should have simple, intuitive interfaces with minimal steps to perform tasks. They should be easy to uses, possibly through large screens. Features like voice commands, large buttons, and clear instructions can accommodate low digital literacy and make the apps more accessible/usable.

"Health tips" should be part of the app to increase the awareness of the health-enhancing effects of regular physical activity and support the participants through their behavior.

Incorporating social and motivational features is also crucial. Apps should include social features that allow users to connect with family, friends, or exercise groups. Motivational elements such as tracking progress, setting personalized goals, and providing reminders can help keep users engaged and motivated. Positive communication related to motivational messages could also be included.

Providing technical support and training is essential to overcome technical barriers. Offering personalized tech training/assistance can increase confidence and ability to use health-related apps effectively.

Conclusions

The thematic analysis reveals a population motivated by health and social engagement, yet, varied in their digital skills and access to technology. A physical activity app targeting these users should be simple, socially engaging, and adaptive to health challenges. Organizing themed physical activity events that meet the needs of different **baseline fitness** levels, while providing free **Wi-Fi** and on-site **technical assistance**, could create a series of **social gatherings** that attract more older adults. These events would address both the barriers and facilitators identified, making participation more appealing and accessible. Additionally, offering the possibility to connect with other European groups simultaneously would enhance the sense of **European community** and make the events even more engaging and enjoyable for participants.

Section 2 - REVIEW

EUAPPTIVE: A scoping umbrella review

Title

Barriers and facilitators to engage in digital interventions that focus on increasing physical activity in community dwelling older adults: an umbrella review.

Aim

The primary objective of this umbrella review is to provide an overview of the existing evidence on the barriers and facilitators for engaging in digital interventions that focus on increasing physical activity among community-dwelling older adults.

This review aims to provide a comprehensive understanding of the factors that influence the adoption, sustained use, and effectiveness of these digital interventions, thereby informing the development and implementation of more effective strategies to promote physical activity in this population.

Methods

The PubMed and CINAHL databases were searched for reviews and metanalysis on the topic from 2017 to 2024, to include the newest technology available. We operationalized our search from 2017 because of the limited number of studies earlier published, the substantial changes and evolution in digital technologies and the digital skills and literacy of the older population.

The first search was conducted in April 2024, and was updated in September 2024.

Keywords corresponded to the PICo model from the Joanna Briggs Institute [7] and some additional criteria (see **Table 2.1**).

Table 2.2 – PICo criteria (Joanna Briggs Institute) used for inclusion and exclusion criteria in a scoping umbrella review describing barriers and facilitators on digital interventions focusing on increasing physical activity in community-dwelling older adults

Parameter	Inclusion Criteria	Exclusion criteria
PICo criteria		
P - Population	Community-dwelling older adults, min age 50 (no specific focus on a disease)	Younger populations, or mixed age populations without a separate analysis for older adults. Studies related to a population with a specific disease (e.g. dementia)
I – Phenomena of interest	Studies investigating digital interventions related to increase physical activity	Studies that do not focus on digital interventions and physical activity
Co - Context	Studies conducted in community settings where older adults live independently	Studies involving institutional settings (e.g. nursing homes)
Additional criteria		
Study design	Reviews and meta-analysis, scoping reviews	Umbrella reviews, primary studies
Outcome	Barriers and facilitators	-
Publication date	From 2017 to 2024	Prior to 2017
Language	English	Other languages

Four building blocks of keywords were used to determine the search matrix, namely i) the older adults' population, ii) the physical activity intervention, iii) the digital intervention, and iv) the barriers and facilitators outcome (**Table 2.2**). Each block was combined with the "AND" logical operator.

The search filter in PubMed and CINAHL was used to detect reviews and metanalysis, and studies in the expected publication dates. SR accelerator was used to translate the search matrix created for Pubmed to CINAHL (https://sr-accelerator.com/#/polyglot).

Table 2.3: Search matrix used for systematic search of the studies in PubMed in a scoping umbrella review describing barriers and facilitators on digital interventions focusing on increasing physical activity in community-dwelling older adults.

Building blocks	Search matrix
Population	("aged adult*"[Title/Abstract] OR "Aging"[Title/Abstract] OR "ageing"[Title/Abstract] OR "community-dwelling"[Title/Abstract] OR "elder*"[Title/Abstract] OR "elderly"[Title/Abstract] OR "old adult*"[Title/Abstract] OR "old individual*"[Title/Abstract] OR "old man"[Title/Abstract] OR "old population*"[Title/Abstract] OR "old men"[Title/Abstract] OR "old people"[Title/Abstract] OR "old person*"[Title/Abstract] OR "old woman"[Title/Abstract] OR "old women"[Title/Abstract] OR "older adult*"[Title/Abstract] OR "older individual*"[Title/Abstract] OR "older man"[Title/Abstract] OR "older population*"[Title/Abstract] OR "older men"[Title/Abstract] OR "older people"[Title/Abstract] OR "older person*"[Title/Abstract] OR "older woman"[Title/Abstract] OR "older women"[Title/Abstract] OR "senior citizen*"[Title/Abstract] OR "senior*"[Title/Abstract] OR "Aged"[MeSH Terms] OR "Aging"[MeSH Terms])
Intervention	("acroyoga"[Title/Abstract] OR "aerobic exercise"[Title/Abstract] OR "aerobic training"[Title/Abstract] OR "agility"[Title/Abstract] OR "anaerobic exercise"[Title/Abstract] OR "anaerobic training"[Title/Abstract] OR "balance control"[Title/Abstract] OR "balance training"[Title/Abstract] OR "BFRT"[Title/Abstract] OR "blood flow restriction training"[Title/Abstract] OR "body training"[Title/Abstract] OR "body weight exercise"[Title/Abstract] OR "cardiorespiratory training"[Title/Abstract] OR "cardiovascular training"[Title/Abstract] OR "circuit-based exercise"[Title/Abstract] OR "circuit training"[Title/Abstract] OR "concentric training"[Title/Abstract] OR "coordination exercise"[Title/Abstract] OR "coordination training"[Title/Abstract] OR "cycling"[Title/Abstract] OR "dance"[Title/Abstract] OR "eccentric training"[Title/Abstract] OR "endurance exercise"[Title/Abstract] OR "exercise"[Title/Abstract] OR "exercise therapy"[Title/Abstract] OR "fitness"[Title/Abstract] OR "golf"[Title/Abstract] OR "gym"[Title/Abstract] OR "gymnastics"[Title/Abstract] OR "hike"[Title/Abstract] OR "hiking"[Title/Abstract] OR "HIIT"[Title/Abstract] OR "home-based exercise"[Title/Abstract] OR "hypertrophy training"[Title/Abstract] OR "interval training"[Title/Abstract] OR "isokinetic training"[Title/Abstract] OR "jog"[Title/Abstract] OR "jogging"[Title/Abstract] OR "kaatsu"[Title/Abstract] OR "locomotor activity"[Title/Abstract] OR "martial arts"[Title/Abstract] OR "mind-body therapies"[Title/Abstract] OR "mind-body training"[Title/Abstract] OR "motor activity"[Title/Abstract] OR "motor control"[Title/Abstract] OR "multicomponent"[Title/Abstract] OR "multi-component training"[Title/Abstract] OR

	"muscle activity"[Title/Abstract] OR "muscle stretching exercise"[Title/Abstract] OR "physical activit*"[Title/Abstract] OR "physical training"[Title/Abstract] OR "pilates"[Title/Abstract] OR "plyometric"[Title/Abstract] OR "posture"[Title/Abstract] OR "power training"[Title/Abstract] OR "qi gong"[Title/Abstract] OR "resistance exercise"[Title/Abstract] OR "resistance training*"[Title/Abstract] OR "run"[Title/Abstract] OR "running"[Title/Abstract] OR "SIT"[Title/Abstract] OR "sprint interval training"[Title/Abstract] OR "sprint*"[Title/Abstract] OR "sport*"[Title/Abstract] OR "stability training"[Title/Abstract] OR "strength training"[Title/Abstract] OR "strengthening exercise"[Title/Abstract] OR "stretching"[Title/Abstract] OR "tai chi"[Title/Abstract] OR "tai-chi"[Title/Abstract] OR "training"[Title/Abstract] OR "walk*"[Title/Abstract] OR "walking"[Title/Abstract] OR "weight exercise*"[Title/Abstract] OR "weight lift*"[Title/Abstract] OR "weight training"[Title/Abstract] OR "weightlifting"[Title/Abstract] OR "yoga"[Title/Abstract] OR dancing [MeSH Terms] OR "exercise"[MeSH Terms] OR "exercise therapy"[MeSH Terms] OR "physical fitness"[MeSH Terms] OR "sports"[MeSH Terms] OR "yoga"[MeSH Terms] OR "Tai Ji"[MeSH Terms])
Intervention	("fitness tracker*"[Title/Abstract] OR "smartphone*"[Title/Abstract] OR "smartwatch*"[Title/Abstract] OR "minitablet*"[Title/Abstract] OR "mini-tablet*"[Title/Abstract] OR "wearable device*"[Title/Abstract] OR "portable device*"[Title/Abstract] OR "app-based exercise*"[Title/Abstract] OR "app-based intervention*"[Title/Abstract] OR "application-based intervention*"[Title/Abstract] OR "digital coach*"[Title/Abstract] OR "digital health"[Title/Abstract] OR "digital health coach*"[Title/Abstract] OR "digital health coaching"[Title/Abstract] OR "digital health intervention*"[Title/Abstract] OR "digital intervention*"[Title/Abstract] OR "digital exercise*"[Title/Abstract] OR "exercise app*"[Title/Abstract] OR "fitness app*"[Title/Abstract] OR "health app*"[Title/Abstract] OR "mobile health application*"[Title/Abstract] OR "mobile intervention*"[Title/Abstract] OR "mobile application*"[Title/Abstract] OR "mobile coaching"[Title/Abstract] OR "m-health"[Title/Abstract] OR "mhealth"[Title/Abstract] OR "mobile app*"[Title/Abstract] OR "intervention app*"[Title/Abstract] OR "online"[Title/Abstract] OR "internet"[Title/Abstract] OR "internet-based"[Title/Abstract] OR "e-health"[Title/Abstract] OR "ehealth"[Title/Abstract] OR "electronic health*"[Title/Abstract] OR "health app*"[Title/Abstract] OR "on-line communication"[Title/Abstract] OR "online communication"[Title/Abstract] OR "e communit*"[Title/Abstract] OR "ecoach*"[Title/Abstract] OR "e coach*"[Title/Abstract] OR "tele-care"[Title/Abstract] OR "tele-homecare"[Title/Abstract] OR "tele-health"[Title/Abstract] OR "tele-healthcare"[Title/Abstract] OR "tele-monitoring"[Title/Abstract] OR "telecare"[Title/Abstract] OR "telehealth"[Title/Abstract] OR "telehealthcare"[Title/Abstract] OR "telehomecare"[Title/Abstract] OR "telemedicine"[Title/Abstract] OR "telemonitoring"[Title/Abstract] OR "digital technolog*"[Title/Abstract] OR "mhealth"[Title/Abstract] OR "fitness trackers"[MeSH Terms] OR "smartphone"[MeSH Terms] OR "Wireless technology"[MeSH Terms] OR

	"Digital Health"[MeSH Terms] OR "Internet-Based Intervention"[MeSH Terms] OR "mobile applications"[MeSH Terms])
Outcome	("barrier*"[Title/Abstract] OR "challeng*"[Title/Abstract] OR "constraint*"[Title/Abstract] OR "difficult*"[Title/Abstract] OR "impediment*"[Title/Abstract] OR "limitat*"[Title/Abstract] OR "obstacle*"[Title/Abstract] OR "restrict*"[Title/Abstract] OR "facilitat*"[Title/Abstract] OR "driver*"[Title/Abstract] OR "ease"[Title/Abstract] OR "enable*"[Title/Abstract] OR "assist*"[Title/Abstract] OR “motive*” [Title/Abstract])

Covidence was used for the screening procedure, Endnote was used to search for full texts. All texts that were not available in a free version were found through the SDU library. Screening of title and abstract, and full texts was done by two reviewers (IP and CD). Disagreements were resolved by discussion. When agreement was not reached, a third reviewer was arbiter (PC). Data extraction was completed by one reviewer (CD) and verified by a second reviewer (IP). The data extraction form was created following the suggestions from JBI [7]. Information extracted included authors, date, aims, study design and main data synthesis method of the reviews. Additionally, we included relevant information from the studies within these reviews in our umbrella review: relevant countries, age, publication date range. Themes related to barriers and facilitators that emerged were organized in categories and subcategories, largely following the structure presented by the review conducted by Moore et al. [8].

Results

A total of 221 systematic reviews were screened to assess eligibility (**Figure 1**). Twenty-four duplicates were identified and removed by Covidence. After the screening of title and abstract, 165 studies were found irrelevant. Other 17 studies were excluded after reviewing the full text. Fifteen studies were finally included in the review.

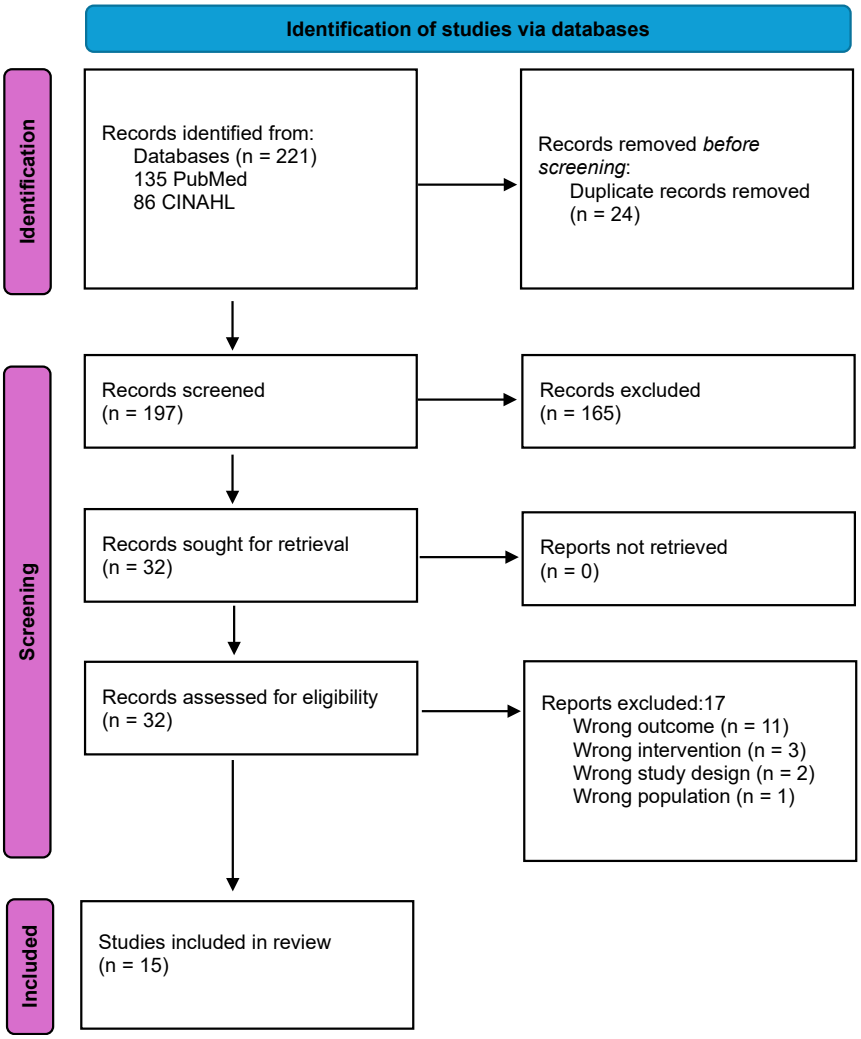

Figure 2.1: PRIMA Flowchart – study screening and selection procedure in a scoping umbrella review describing barriers and facilitators on digital interventions focusing on increasing physical activity in community-dwelling older adults

Publication dates of the 15 included studies ranged from 2017 to 2024, and they included studies from 2006 to 2023. Studies were conducted in 21 different countries, and included both quantitative, qualitative and mixed studies (**Table 2.3**).

Table 2.3: Main characteristics of 15 studies included in a scoping umbrella review describing barriers and facilitators on digital interventions focusing on increasing physical activity in community-dwelling older adults.

First author Year, Ref number	Type of review	Data synthesis methods	Relevant studies included	Relevant countries	Relevant indication about age: -mean -range -other	Relevant publication date range
Ashe 2024 [9]	Systematic of RCTs	Quantitative	2	Australia	74,95 - NR - NR	2021
Baer 2022 [10]	Systematic	Mixed	2	Germany, USA	52,4 - NR - NR	2016-2019
Changizi 2017 [11]	Systematic	Quantitative	1	Malaysia	NR – 55 to 77 - NR	2016
Gomez-Hernandez 2023 [12]	Systematic	Quantitative	40	NR	NR - NR – 60+	2010-2021
Gravesande 2023 [13]	Scoping	Mixed	11	Canada, Hong Kong, UK, USA	67 - NR - NR	2006-2022
Greco 2023 [14]	Narrative	Mixed	3	Canada, Greece, USA	67 - NR - NR	2013-2016
Hosseinpour 2019 [15]	Systematic	Mixed	6	USA, Finland, Norway, UK, Netherlands	55,3 - NR - NR	2010-2018
Jin 2022 [16]	Systematic	Qualitative	5	Canada, Ireland, USA	54,8 - NR - NR	2014-2018
Moore 2021 [8]	Systematic and meta-synthesis	Qualitative	20	Ireland, Finland, UK, Sweden, Norway	NR – 51 to 94 - NR	2015-2020
Oliveira 2022 [17]	Systematic and meta-analysis of RCT	Quantitative	1	USA	67 – 55 to 80 - NR	2011
Shekelle 2024 [18]	Systematic and meta-analysis	Quantitative	1	USA	NR - NR – 60+	2011-2021
Tao 2024 [19]	Scoping and meta-synthesis	Mixed	2	Brazil, Australia	NR – NR - 50+	2018-2023
Tsai 2024 [20]	Systematic and meta-analysis	Mixed	4	Netherlands, Singapore, Switzerland, Sweden	NR - NR – 50+	2019-2022
Wilson 2022 [21]	Systematic	Qualitative	11	New Zealand, Australia, France, Germany, China, USA, Slovenia, Scotland	NR - NR – 50+	2014-2019
Yau 2022 [22]	Systematic	Mixed	1	Canada	65 - NR - NR	2017

Abbreviations: NR, not reported.

Description of barriers and facilitators

In general, more facilitators than barriers were mentioned. The most cited barriers identified included age-related physiology and comorbidities, followed by technical aspects (data not shown). On the other hand, most mentioned facilitators were technical aspects and instructions and guidance.

Barriers and facilitators

In the various systematic reviews that were conducted, a range of barriers and facilitators were identified that influenced adoption and use of digital devices (such as wearable watches, iPhone, iPad and others) for physical activities.

We have divided them in three categories (openness to engage and functional ability of the user, motivation for device use, integration into daily life), and fourteen subcategories (**Table 2.4**).

Table 2.4: Barriers and facilitators of the 15 studies included in the scoping umbrella review.

Barrier (B) and/or Facilitator (F)		Ashe 2024		Baer 2022		Changizi 2017		Gomes-Hernandez 2023		Gravesande 2023		Greco 2023		Hosseinpour 2019		Jin 2022		Moore 2021		Shekell 2024		Solis 2020		Tao 2024		Tsai 2024		Wilson 2022		Yau 2022	
		B	F	B	F	B	F	B	F	B	F	B	F	B	F	B	F	B	F	B	F	B	F	B	F	B	F	B	F	B	F
Openness to engage and functional ability of the user	Age related physiology and comorbidities							☑								☑		☑									☑	☑			
	Self-efficacy for technology																☑	☑	☑					☑	☑						
	Knowledge and confidence			☑														☑	☑		☑							☑	☑		
	Sense of independence									☑								☑	☑				☑				☑				
Motivation for device use	Intrinsic motivation																	☑							☑						
	Extrinsic motivation and social support													☑				☑		☑				☑							
	Awareness of physical activity											☑	☑			☑	☑	☑					☑				☑				
	Goal setting and quantification	☑													☑																
	Feedback						☑						☑		☑			☑					☑				☑		☑		
Integration into daily life	Privacy aspects			☑											☑				☑										☑		
	Accessibility			☑		☑		☑	☑				☑				☑							☑				☑	☑		
	Technical aspects							☑	☑										☑	☑				☑				☑	☑		☑
	Instructions and guidance		☑						☑		☑							☑	☑		☑				☑	☑		☑			
	Cost										☑					☑													☑		

1. Openness to engage and functional ability of the user

Openness to engage and functional ability refers to the willingness and readiness of an individual to interact with and embrace new technologies or activities. Besides, it also refers to the individual's capacity to effectively use and interact with digital devices and technologies.

The following sub-categories were identified: age-related physiological changes and comorbidities, self-efficacy, knowledge and confidence and sense of independence.

Age-related physiological changes and comorbidities

Older adults often experience physical limitations such as reduced motor skills, which makes interacting with small or closely spaced touchscreen controls difficult, reducing their willingness to engage [19]. This can result in accidental taps or require a level of precision they may struggle to provide [12]. Another review also emphasized that increasing hand tremors occurring in older age further hinder the ability to use modern touchscreens effectively [8]. Wilson et al. (2022) [21] highlighted how sensory impairments, such as diminished vision or hearing, contribute to difficulties in using digital devices.

"*I have difficulty reading signs and anything small. So I would automatically go for the biggest tablet.*" [23]

Jin et al. (2022) [16] similarly noted that both physical and cognitive limitations reduced older adults' engagement with technology: slower processing speeds and an inactive lifestyle decreased the relevance of such devices in their daily lives.

In summary, older adults faced significant barriers to using new technologies due to a combination of physical, cognitive, and sensory limitations. These challenges made it difficult for them to interact with touchscreen devices, often resulting to frustration and disengagement. However, according to Tsai et al., devices that promote physical activity, cognitive support, and daily tracking can address these challenges [20].

Self-efficacy

Self-efficacy refers to an individual's belief in their ability to successfully engage in specific tasks [24].

Many older adults tend to have lower self-efficacy related to technology, meaning they lack confidence in their ability to use technology effectively. A low self-efficacy can negatively impact a user's attitude towards technology, limiting the perceived ease of use and leading to reduced adoption [8]. Some participants commented that technological devices were not built with older people in mind, that they created for someone younger, with higher technological competences [8]. Some authors pointed out that familiarity with digital platforms is essential [19]. Without prior experience, older adults may experience lower self-efficacy, which in turn diminishes their willingness to participate in technology-driven activities.

High self-efficacy leads to higher motivation and compliance with tasks, which increases confidence in performing exercises and engaging in new activities [19], and may also lead to higher engagement with apps and devices [8].

Knowledge (and confidence)

Some authors explained that for many the lack of knowledge and familiarity with smartphones or tablets is a barrier, as they have had limited exposure to or education about these devices [21]. Participants frequently express concerns or fears about using tablets and other technological devices, often citing their lack of knowledge or confidence. This fear of knowledge is further heightened by the perception that technological

equipment could be dangerous, like breaking the device or difficult to handle it. Such negative feelings toward devices can result in their abandonment [8].

"*I'm just frightened in case I go in somewhere and then I can't get out. You know how they talk about the Trojan viruses and all that spyware and all the rest of it? That's what I'm frightened of, especially when you don't know.*" [23]

Additionally, individuals with lower levels of formal education may face greater challenges in learning and using technology, further diminishing their confidence and engagement, and discouraging them in using technological devices [21].

On the other side, older adults with some technological experience are more likely to explore apps [8], or use smartphones or tablets [21]. Shekelle et al. (2024) mentioned the importance of skills development, noting that internet training programs can improve confidence and comfort with technology [18].

Sense of independence

A sense of independence is crucial for many older adults. Devices that require frequent need of assistance or even just charging can interrupt people's routines and create a threat to live the independent life they would like [8]. Moreover, older adults may be hesitant to seek help or involve family members when using technology, as they often prefer to manage it independently. However, this desire for self-reliance can become a significant barrier to receiving the support they need [8].

Some authors mentioned also that when participants used digital devices at home in combination with physical activity they faced challenges in their home setup. They mentioned having little space to do the exercises, poor lighting, and a lack of privacy because they shared their living space with family or roommates. Background noise, like barking dogs, and distractions from their pets also made it harder for them to focus [13].

Devices that promote autonomy, by being easy to use and requiring minimal external assistance, are more likely to be embraced by older users. Such tools empower them to manage their tasks without constantly relying on others, enhancing their confidence and self-reliance [16]. Additionally, for those with mobility issues, the ability to engage remotely from the comfort of their home further strengthens this sense of independence [17].

2. Motivation for device use

User motivation is crucial. Without it, the device will simply be seen as another piece of technology [8].

The following sub-categories have been used: intrinsic motivation, extrinsic motivation and social support, awareness of physical activity, goal setting, and quantification and feedback.

Intrinsic motivation

It refers to engaging in an activity for its own sake, because it is found enjoyable or satisfying.

"*I was motivated by the technology, that I freely admit.*" [25]

"*The technology has no impact on my motivation, I am physically active anyway. I am on the verge of getting diabetes, that is what motivates me the most*." [25]

Intrinsic motivation has been identified as an important facilitator for physical activity, especially for older adults who are inactive but wish to change their physical activity level. These individuals believe that a wearable device can encourage them to improve their activity level, while those already active may not feel this need. Additionally, this motivation was especially present among older adults with lower incomes, as they viewed the device as a valuable tool to help them achieve health goals they currently felt were unattainable without additional support [8].

Tao et al. [19] found that activities like exergaming can reinforce intrinsic motivation in individuals who find the experience enjoyable and comfortable.

Extrinsic motivation and social support

A social network and the engagement with peers are components that may influence behaviours both in the short and long term. Social encouragement, especially from family and friends, plays a crucial role in motivating older adults to start using and learning digital devices [8]. Some users reported that support from their social circles gave them the necessary push to engage with technology [21].

"Long-term users indicated social support to be the main motivational factor, with the focus on building relationships around daily activity routines." [26]

Within the field of technology, peer engagement through a platforms or apps needs also to be considered. Social sharing has been shown to increase engagement with technology [18] and physical activity in various situations. And sharing progress with unfamiliar individuals can also motivate increased physical activity [15]. Furthermore, quantitative studies showed that competition groups engaged in higher levels of physical activity compared to groups without competition [15]. This may not be valid for everyone. Tao et al. explained that the shift to virtual formats often limits social engagement, reducing awareness of the benefits of physical activity. This lack of direct interaction makes it harder for older adults to fully appreciate the positive effects of staying active [19].

"*I think they're [younger people] missing a lot of human interaction, because they are so focused on the screen and machines*" [23].

Awareness of physical activity

Although awareness of physical activity does not automatically lead to the necessary motivation, it can act as a catalyst that sparkles interest [8].

To be aware of your physical activity, the devices need to show correct results. Some authors pointed out that issues such as an accelerometer's that is ineffective to detect certain activities, like cycling, along with non-personalized automatic feedback and high battery consumption, can undermine the effectiveness of these

devices [14]. Similarly, in a review on self-tracking it was noted that inaccurate data diminishes the perceived usefulness of fitness trackers, which is a significant barrier to their widespread adoption [16].

Moore et al. also observed that negative emotions, such as disappointment, arise when fitness trackers fail to deliver reliable measurements. This underscores the critical role of technological reliability in shaping users' perceptions and attitudes toward new technologies and their awareness of physical activity. Trustworthy and accurate data are really important for sustaining user engagement and confidence in technology [8].

Wearable devices like smartwatches, equipped with accelerometers and pedometers, help elderly individuals track steps, energy expenditure, and sedentary behavior. These tools, when paired with mobile devices, enable continuous monitoring of physical activity [14]. Some studies showed that older adults using activity trackers report increased daily steps and improved engagement in physical activity. This heightened awareness encourages them to stay active and achieve fitness goals [17, 20].

Goal setting and quantification

According to the CALO-RE Taxonomy of behaviour change technique, goal setting involves encouraging individuals to initiate or sustain behaviour changes as part of an intervention [27].

Goal setting is a crucial action plan designed to achieve desired results in physical activity. It provides users with clear direction on what needs to be accomplished, and the efforts required to do so [15]. Hosseinpour et al. indicated that users assigned "low" goals often report positive effects on their physical activity levels. These lower goals tend to be less challenging and are typically framed as an absolute increase in activity, such as a 10% weekly increase in daily steps, or as a gradual progression [15].

Users often express dissatisfaction when their performance doesn't align with the expected parameters of an exercise program. For example, if exercises take longer than anticipated, frustration can arise, especially when users find the workouts repetitive. While repetition is crucial for improvement, this perception can diminish overall satisfaction [9].

Feedback

Feedback is essential in enhancing user engagement and satisfaction with an app. When feedback is inadequate or missing, users may feel frustrated and perceive less value in the application. As noted by Moore et al., insufficient feedback can lead to a disconnect between the user and the device, hindering the device's effectiveness in helping users achieve their goals [8].

Moreover, the absence of timely and personalized feedback significantly impacts users' motivation and engagement. Users rely on clear feedback to monitor their progress, and without it, the experience becomes less rewarding, potentially leading to disengagement. Future iterations of fitness and health apps should prioritize reducing downtime between exercises and delivering immediate, constructive feedback. This strategy can enhance user satisfaction and facilitate the successful scaling of these applications [8].

"Because you've got the instant feedback to see how you get on, so that's how it was different because it had a focus. It just tuned you in and it got you into the type of the pattern and the routine of having the focus and … well it was much easier to get into a pattern or routine with this focus and getting the feedback, and getting 'yes I achieved a target today' or 'I'm nearly there'". [28]

Participants who received feedback increased their physical activity compared to those who didn't receive feedback. Feedback reveals participants' actual ability to engage in physical activity, boosting their motivation and enhancing their self-efficacy [15].

According to Wilson et al. (2022), feedback in the form of alerts, reminders, and notifications can assist users in organizing their tasks. Reminders to follow exercise routines have in fact been linked to improved adherence to physical activity [21]. Short Message Service (SMS) notifications are particularly favoured by older adults due to their simplicity and low technological skill requirements [11].

Activity trackers provide quantifiable feedback, resulting in measurable increases in physical activity, often leading to an increase of approximately 1,550 steps per day [17]. It was suggested by some participants that diversifying and tailoring physical activity messages, incorporating reminders for app use, refining technical aspects, and improving the user interface could enhance the appeal of these interventions [20]. Ultimately, individual preferences and a person-centred approach are crucial for driving positive digital engagement in physical activity initiatives [20].

3. Integration into daily life

To integrate digital devices into daily life, several factors come into play, including: i) privacy concerns, ii) accessibility and usability, iii) technical aspects, iv) instructions and guidance and v) the cost of devices.

Privacy

Collecting personal information in the digital application carries a risk of being repurposed, leaked, or accessed by unauthorized third parties [20]. Some authors mentioned in their review that older participants in physical activity programs expressed privacy concerns when sharing their experiences with strangers in segregated groups. For example, they feared that information could be used by health insurance companies and commercial parties. They feared that their information could lead to higher insurance costs or be used for marketing purposes [10].

Accessibility and usability

Accessibility and usability issues may hinder the use of digital devices for physical activity among older adults. In the review from Baer et al., participants emphasized that ease of use is crucial, particularly in tasks like manual data entry and the need to carry a mobile phone constantly [10].

Moreover, Gravesande et al. highlighted that access to electronic devices and reliable internet posed another significant barrier. Many studies in this review required participants to own a smartphone, computer, or tablet and have stable internet access at home, limiting participation for those without these resources [13].

The portability of a device is one of the factors cited in the review of Wilson et al. [21]. Users highlighted portability as important, the lightweight and mobile nature of devices such as smartphones and tablets as convenient for on-the-go use. Perceived "Ease of Use" has also a positive impact on people's willingness to use technologies. According to Jin et al, features like automatic tracking make these devices easier to use, encouraging adoption and use of the device over time [16].

Technical aspects

Various researchers have identified multiple technical challenges in using digital devices to promote physical activity among older adults. For instance, Gravesande et al. (2023) [13] reported that users frequently encountered barriers with basic device functions, such as using mute/unmute, logging in, and experiencing issues with audio and video quality, including echoing, pixelation, or delays. These issues were often linked to poor network connectivity or the lack of capacity in using a network connection. Similarly, [18] Other authors found that the complexity of certain platforms, especially if difficult to navigate, can discourage users. Additionally, Wilson et al. (2022) [21] observed that participants cited device-specific issues like screen size, battery life, and overly complicated interfaces as further deterrents. Addressing these technical barriers is crucial for enhancing user engagement in physical activity programs; digital tools must be accessible, user-friendly, and adaptable to meet diverse needs and environments.

Gomez Hernandez et al. (2023) [12] offered design guidelines for mobile apps targeting older adults, focusing on reducing distractions, simplifying navigation, and making interactive elements easy to access. Notably, they highlighted that older users often struggle to maintain focus, so reducing secondary functions and emphasizing the primary button or action on each screen can ease navigation. They also advised against placing interactive controls near the screen's edges, where they could be accidentally tapped. Central placement of interactive features and safe exit options on every screen can help reduce anxiety and guide users effectively through each step.

To simplify navigation, it was recommended to minimize the number of on-screen options, using concrete, familiar icons with text labels, and ensuring that icons closely relate to their functions for ease of recognition. They cautioned against assuming that older adults are familiar with conventional symbols (e.g., a question mark for help or an arrow for sending a message) and encouraged the use of culturally adaptive and intuitive symbols instead [12].

To address cognitive overload, it was advised using concise instructions and larger font sizes, acknowledging that age-related declines in visual acuity necessitate readability enhancements. High contrast between foreground and background colors was also recommended to improve readability, particularly in low-light conditions or on screens with reduced brightness [12].

Finally, device hardware characteristics, such as display size, battery life, and comfort, play a crucial role in influencing preferences for mobile devices among older adults. Larger screens (like those on tablets or iPads) were favored over smartphones due to improved visibility and ease of use [21, 22].

Instructions and guidance

Instructions and guidance are essential, especially for older adults who may have lack of confidence in using digital tools without assistance [20]. Moore et al. mentioned in their review that many older participants reported that when instructions are provided, they are often too technical to understand. Additionally, when seeking help, they frequently encounter situations where others complete tasks for them, rather than guiding them through the process [8].

The ease of integrating technology into daily life depends on several factors, such as the device's features, its day-to-day functionality, purpose, and reliability [8]. Older adults living alone often display negative attitudes toward health-assistive apps on smartphones, likely because they perceive these devices as replacements or

threats to in-person services. Furthermore, individuals in this demographic may lack access to adequate support or instruction for learning how to use technology effectively [21].

Some authors reported that older adults said that clear and structured instructions are crucial to facilitate participation in technology-based activities and ensure effective behaviour change [9]. For instance, the use of social support tools, such as artificial intelligence chatbots, can help guide them through tasks.

In their systematic review, Gomez Hernandez et al. (2023) delivered some guidelines on how to make an app for older adults [12]:

i. To effectively guide users in using the app, offering initial face-to-face training can be particularly beneficial for older adults. This approach is especially valuable for critical applications, such as healthcare or personal finance. If face-to-face doesn't work, video tutorials can also be highly useful. While written instructions can accompany videos, they should never be the only form of support provided. Older users prefer the clarity and engagement of video guides. Step-by-step instructions are also very important.
ii. Using multisensory feedback can address common perception limitations among older users. For instance, combining auditory and visual cues helps ensure that critical information is conveyed correctly. Feedback after an action, such as tapping a control button, should be bold and clear, as subtle feedback might go unnoticed.
iii. Timing: another important consideration is to increase response time and feedback duration on the screen. This allows older adults enough time to interpret the screen and decide on the next step. Pop-up messages or other critical information should remain visible long enough for users to process, preventing confusion or errors.

Moreover, ongoing technical support during the learning process is critical. One-on-one technical support, both before and during a program, can ease initial technical challenges and help older adults develop confidence in using the technology [13].

"*If you're sitting there by yourself trying to read the instructions that would be quite scary*" [23].

Diverse training content is beneficial when introducing older adults to technology. Programs that range from basic to advanced skills, including internet training, help participants become more comfortable with devices and the online world [18].

Finally, ensuring that instructions and safety recommendations are clear helps build confidence and understanding, especially when older users engage with mHealth apps to track health or motivate behaviour changes [19]. By providing accessible knowledge, guidance, and support, designers can greatly enhance the overall user experience and technology adoption by older adults [8].

Cost

High upfront expenses for smartphones or tablets can pose a significant barrier, particularly for individuals from lower socioeconomic backgrounds [21].

"*Cost comes into it. It's not so bad nowadays, but it came into it*" [23].

"*Often with technology, if it's a low price, you've probably got fewer facilities*" [23].

However, despite costs, many have found smartphones and tablets to be affordable alternatives to traditional care. The wide range of smartphones and tablet devices available today at varying price points makes technology more accessible than ever before, enabling greater adoption across different economic groups [21].

Furthermore, looking at services that technology can provide, online delivery of services can save participants both time and money by eliminating the need to travel, which is particularly beneficial in bad weather conditions [13].

Recommendations

In their review, Gomez et al. (2023) [12] focused on making mobile apps more accessible for older adults. Their recommendations represent a good summary of the main features to take into account when planning to design or use a mobile app for older adults.

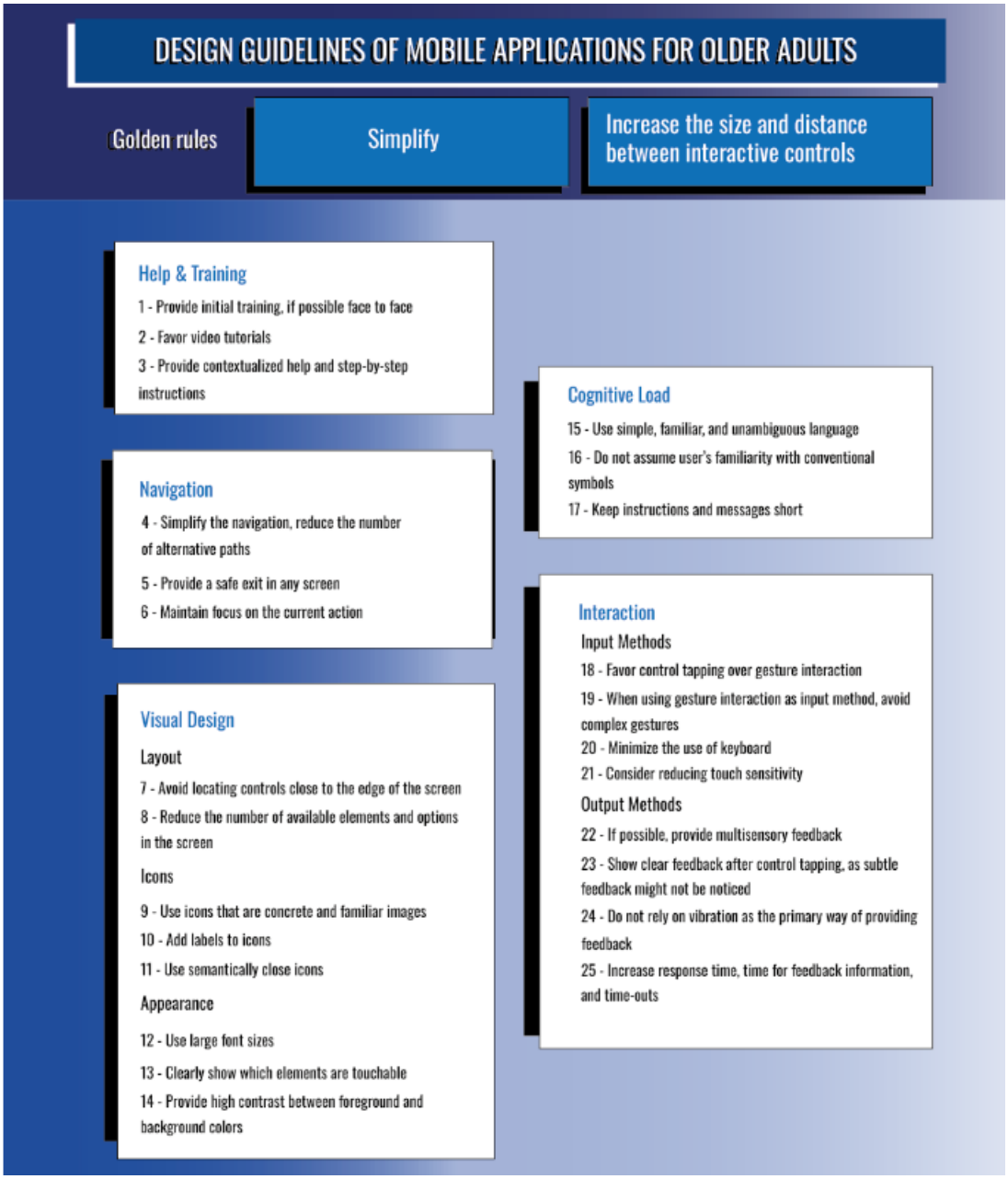

Figure 2 : Design guidelines of mobile application for older adults by Gomez et al. (2023) [12].

The authors mentioned two golden rules which are the most important factors to keep in mind when designing a mobile application: simplify and increase (**Figure 2**).

1. Simplify the design and user experience to make the app more intuitive and easier to navigate.

2. Increase the size and distance between interactive controls: make buttons and controls larger and spaced apart to prevent accidental taps and make them easier to interact with.

Moreover, the authors provided the following recommendations:

Help & Training

- Video tutorials: use videos for step-by-step learning.
- Contextual help: provide clear, relevant instructions that are easy to follow.

Navigation

- Simplified navigation: keep the layout straightforward to avoid confusion.
- Safe exit options: ensure users can easily go back or exit from any screen.
- Focus on current tasks: minimize distractions by keeping attention on one task.

Visual Design

Layout

- Keep controls away from the screen edges to prevent accidental taps.
- Reduce the number of elements on the screen for a cleaner look.

Icons

- Use familiar, easily recognizable icons with labels.
- Ensure icons are related to their functions to avoid confusion.

Appearance

- Use large fonts for readability.
- Clearly indicate which elements are interactive.
- Maintain high contrast between text and background for visibility.
- Use big screens

Cognitive Load

- Simple language: use clear, straightforward language; avoid jargon.
- Avoid assumptions: don’t assume users know common symbols; explain them.
- Concise instructions: keep messages short and to the point.

Interaction

Input Methods

- Favor tapping over complex gestures.
- Limit the need for keyboard input.
- Consider adjusting touch sensitivity to reduce accidental inputs.

Output Methods

- Use multisensory feedback (visual and audio) for better understanding.
- Provide immediate, clear feedback after user interactions.
- Allow sufficient response time before time-outs

Conclusions

When planning interventions to increase physical activity among older adults through digital means, it is essential to consider both the barriers and facilitators identified. Tailoring interventions to address the specific needs and challenges of older adults will enhance their effectiveness. By providing the necessary support, designing user-friendly devices, and fostering a supportive social environment, we can significantly improve the adoption and sustained use of digital devices for physical activity.

Section 3 – APP Market Review

Digital tools are becoming an integral part of physical activity programs. Among these, mobile applications offer unique opportunities to support and motivate users through tracking, reminders, social connections, and personalized guidance. Given the increasing need for accessible and adaptable tools for older adults, we reviewed a selection of physical activity apps to identify features and design elements particularly suited to this population. Below is a curated list of effective urban physical activity programs that use digital solutions. These examples highlight features that could be valuable for community-dwelling older adults, enhancing their engagement and supporting long-term, healthy activity habits. **Table 3.1** gives an overview of some features present in the apps described. The organization of this table largely follows the structure presented by Soto-Bagaria et al. (2023) [29].

Health Campaign apps

The apps that are mentioned bellow are primarily developed as a part of public health initiatives to promote physical activity in a community or at national level. They want to increase awareness and engagement about physical activity through the use of campaigns and apps.

1. **Active 10 (UK)**

https://www.nhs.uk/better-health/get-active/

Active 10 is a public health campaign by Public Health England that encourages people to do at least ten minutes of brisk walking each day. The program uses a mobile app to track walking activity, provide feedback, and helps you set goals. The app also offers motivational tips and reminders, making it easier to incorporate physical activity in the daily routine.

- Anonymously records every minute of walking you do. Just by popping your phone in your pocket and away you go.
- Instead of focusing on extensive exercise sessions, the app encourages users to walk briskly for just 10 minutes a day. When you do 10 minutes of fast walking, the app will reward you with a badge.

2. **10,000 Steps Program (Australia)**

https://www.10000steps.org.au/about-us/The 10,000 Steps program encourages participants to walk 10,000 steps a day using pedometers and digital tracking tools. The program includes a website and mobile app where users can log their steps, set goals, and participate in challenges. It has been successful in increasing physical activity levels among urban residents by providing a simple, accessible way to track and motivate daily activity.

Characteristics/adaptions for older adults:

- Set yourself a daily step goal: While the program promotes walking 10,000 steps a day, older adults can set personalized, more achievable goals, especially if they have mobility or fitness limitations.
- Join challenges and connect with friends and family: Group challenges foster community engagement and social support, helping older adults stay motivated, which is important as they may feel isolated.
- Physical Activity Reminders: Gentle reminders and notifications can help older adults remember to stay active, addressing potential memory issues or a sedentary lifestyle.

3. **Go4Life (USA)**

https://www.nia.nih.gov/research/blog/2014/07/go4life-nia-health-education-campaign

https://go4life.nia.nih.gov/

Developed by the National Institute on Aging, Go4Life is a program tailored specifically to older adults. It offers exercises designed to improve endurance, strength, balance, and flexibility. The program provides online resources, videos that includes a variety of exercises that can be done at home or outside.

- Low-impact exercises options: it focuses on exercises that are gentle on joints, addressing mobility and physical limitations.
- Customization based on health conditions: it offers specific guidance for users with common age-related conditions, such as arthritis or osteoporosis.

Challenge apps (private companies):

The following are challenges team challenges or challenges to promote physical activity through apps promoted by private companies.

1. **Tælskridt (Denmark)**

https://www.taelskridt.dk/

The "Tæl Skridt" initiative is a step-counting campaign organized by Dansk Firmaidræt in Denmark. It aims to promote daily physical activity, especially for those with sedentary jobs, by encouraging participants to walk 10,000 steps a day. Participants, including workplace teams, can track their steps using pedometers, fitness trackers, or smartphone apps, and even convert other forms of exercise into steps using a converter tool.

The campaign is structured around multiple annual events where teams compete internally and nationally. Participants can submit steps daily. If steps are above a certain amount, you participate in a lottery for a chance to win a prize. Motivational features like daily tips and competitions for most active captains keep engagement high throughout the campaigns. Teams can track progress and rankings on their dashboard and even submit steps via SMS.

2. **StepJockey (UK)**

https://stepjockey.freshdesk.com/support/home

StepJockey promotes stair climbing in office buildings and public spaces by using smart signs and a mobile app to track and encourage stair use. The app allows users to scan QR codes on signs placed near staircases to log their activity and participate in challenges. This program has been effective in increasing physical activity in urban workplaces.

- Incremental, Low-Impact Activity: Stair climbing is a convenient and accessible way for older adults to incorporate physical activity into their day without needing formal exercise equipment or routines.
- Visual Cues with Smart Signs: By placing signs near staircases and allowing QR code scanning, the app reduces the need for complex technology interactions, making it accessible for those who may struggle with mobile apps.

Exercise and/or monitoring apps

These apps are developed by private companies and are focused on individual physical activity, tracking, monitoring and personal challenges.

4. **SilverSneakers GO (USA)**

https://www.ncoa.org/adviser/healthy-living/silver-sneakers-review/

SilverSneakers is a popular fitness program for older adults, and the SilverSneakersGO app allows users to get access to workout programs and join virtual fitness classes. The app includes features like workout reminders and personalized programs. Silver Sneakers is only free to people with a Medicare Advantage plan.

- Offers group classes via the app, allowing older users to stay active from home or at the gym.
- Customizable programs to accommodate various fitness levels, from beginners to more active older adults.

5. **FitOn (USA)**

https://www.fitonhealth.com/

https://www.prnewswire.com/news-releases/digital-fitness-platform---fiton---announces-the-launch-of-fiton-health-and-new-programs-focused-on-seniors-and-people-managing-chronic-conditions-301538093.html

FitOn is a free fitness app that offers on-demand workout videos, including options for older adults. The app covers a wide range of activities such as stretching, yoga, strength training, and cardio.

- Specific workout videos for older adults: Provides low-impact workout options specifically designed for older adults.
- Option to pause and rewind: Allows users to go at their own pace, which can be beneficial for those new to certain exercises.
- Available Anytime, Anywhere: The app's flexibility allows older adults to access classes at their convenience, removing the need to stick to rigid schedules.

6. **Runtastic (Adidas Running)**

https://www.runtastic.com/

Known for its user-friendly design, Runtastic is ideal for tracking activities like walking and running, and it offers audio cues and motivational feedback throughout workouts. It has a strong social component, allowing users to connect with friends or family, which can boost motivation and provide a sense of community. The free version includes basic tracking features, while a paid subscription adds personalized training plans and advanced tracking.

7. **Nike Training Club**

https://www.nike.com/ntc-app

This app provides a variety of workout routines across fitness levels, with a substantial amount of free content, including tutorials and instructional videos. Nike Training Club's structured workouts and user-friendly video guidance are especially suitable for older adults who appreciate clear instructions and flexibility in workout intensity. A premium subscription is available, though the free version has enough variety for many users.

8. **MapMyWalk**

https://www.mapmywalk.com/

MapMyWalk is highly popular among walkers and is well-suited to those who prefer low-impact activities. It tracks routes, steps, and distance, and even provides route suggestions, making it easy for older adults to plan safe walking paths. The free version includes all essential tracking features, with a premium plan available for features like advanced analytics and personalized routes.

9. **Strava**

https://www.strava.com/about

Although originally popular among athletes, Strava's simplicity and social sharing features have made it popular with all fitness levels, including casual walkers. The app lets users track a range of activities and connect with others in walking groups or virtual clubs, which is beneficial for older adults seeking a sense of community. The free version offers basic tracking and social features, while the premium version adds advanced training tools and route planning.

WeWalk (https://wewalk.io/en/) is not an exercise program, but it is a smart cane designed for visually impaired individuals, equipped with sensors and a mobile app that provides navigation assistance and tracks physical activity. Its app is worth mentioning as it connects to public transportation systems, making it easier for users to navigate urban environments and stay active.

- The app and smart cane are designed with sensors and audible feedback to help visually impaired users navigate safely, which is especially beneficial for older adults experiencing vision decline.
- By connecting to public transportation systems and providing navigation help, the app addresses common mobility barriers faced by older adults, who may be less comfortable navigating unfamiliar environments.

Even without dedicated extra health programs, most smartphones come today with some built-in features for tracking physical activity. For **Apple** users, the **Health** app is pre-installed on iPhones. This app automatically counts your steps and measures distances walked and run. If you have an Apple Watch, the app further tracks your activity data and provides a good view of your fitness progress (https://support.apple.com/nl-nl/104997).

For Samsung users, **Samsung Health** serves a similar purpose. It allows you to monitor your daily step count and can aggregate data from connected devices, such as smartphones and smartwatches. This can sometimes make it challenging to determine the step count from each device. However, Samsung Health allows you to adjust settings to view your total steps across activities like walking, running, or other exercises, as well as the step count for individual devices (https://www.samsung.com/us/support/answer/ANS10001370/).

Table 3.1: Main features included in some physical activity apps

App	Objective	User/Target	Elements included								
			Education	Self-monitoring	Goal setting	Feedback	Gamification	Adaption/ Progression	Peer network	Energy expenditure	Step count/ Stair climbs
Tælskridt	Encouraging participants to walk 10,000 steps a day	Everyone at the working place	☑	☑	☑	☒	☑	☒	☑	☒	☑
10,000 Steps Program	Increase awareness and participation in physical activity	Everyone	☑	☑	☑	☑	☑	☑	☑	☑	☑
Active 10	Do at least ten minutes of brisk walking each day	Everyone	☑	☑	☑	☑	☑	☒	☒	n.f.	☑
StepJockey	Create a heathier world by labelling it for calorie burn	Everyone	☑	☑	☑	☑	☑	☒	☑	☑	☑
Go4Life	Provide practical tips and options for older adults, so they design their own exercise routines	Older people	☑	☑	☑	☑	☒	☑	☒	☒	☒
SilverSneakers GO	Eliminate barriers like cost and accessibility facing older adults seeking out fitness programs	Older adults	☑	☑	☑	☒	☒	☑	☒	☒	☒
FitOn	Get people to their healthiest	Everyone	☑	☑	☑	☑	☑	☑	☑	☑	☒
Runtastic	Stay motivated, push your limits, achieve goals	Everyone	☑	☑	☑	☑	☑	☑	☑	☑	☒
Nike Training Club	Training For Every Body and Mind.	Everyone	☑	☑	☑	☑	☑	☑	☑	☑	☒
MapMyWalk	Reach your best	Everyone	☑	☑	☑	☑	☑	☑	☑	☑	☒
Strava	The philosophy is: if you exert yourself, you are an athlete.	Everyone	☑	☑	☑	☑	☑	☑	☑	☑	☒

Abbreviations: n.f.: Not found; ☑ characteristic present; ☒ characteristic not present.

General Adaptations for Older Adults:

The most interesting characteristics found that adapt well to our target population are:

- *User-Friendly Interfaces*: older adults may experience difficulties navigating complex digital platforms. Apps should have simplified, intuitive layouts, larger buttons, and adjustable text size for easier use.
- Low-Impact Exercise Options: many older adults may face limitations related to joint pain, reduced mobility, or chronic conditions. Apps that offer exercises should provide exercises that accommodate these needs, offering alternatives to high-intensity activities.
- Social Features: integrating social components, such as the ability to join group challenges, share progress with friends or family, or engage in virtual communities, can help combat feelings of isolation and increase adherence to exercise routines.
- Motivational Prompts: personalized reminders, daily activity goals, and motivational messages can help older adults stay engaged and consistent with their physical activity.
- Integration with wearable devices: apps that can sync with wearable technology (e.g., fitness trackers, smartwatches) allow users to easily track their physical activity and monitor important health metrics like heart rate or steps.
- Accessibility options: voice commands, audio feedback, or visual aids can assist users with impairments, making the app more inclusive for a broader range of abilities.

Final guidelines for municipalities and public health authorities:

Digital interventions to increase physical activity could represent **complementary** strategies to traditional, in-person programming and community-based physical activity initiatives, offering an additional way to reach diverse populations and accommodate varying preferences and abilities. Practical recommendations for municipalities and public health authorities to enhance the reach and effectiveness of digital interventions take into account the need for:

1. Inclusivity and accessibility

- **Device accessibility**: to be more inclusive, ensure the program accommodates participants without smartphones by offering alternatives, like paper-based tracking.
- **Design simplicity**: apps should have intuitive interfaces, large buttons, and minimal steps to navigate.
- **Device compatibility**: ensure the app is accessible on Android/iOS smartphones, tablets, and PC/Apple computers to accommodate different user preferences and device availability.
- **Sound and audio guidance**: include a sound option for key instructions or feedback for participants who benefit from audio cues, accommodating those with visual impairments.
- **Offline functionality**: where possible, enable offline use for participants with limited internet access.

2. Tailored technical support

- **Onboarding and training**: provide a form of initial in-person or virtual training to get familiar and build confidence in using digital tools, along with ongoing support.

- **Dedicated tech assistance**: establish a way to provide technical (support stations or hotlines for troubleshooting), with community volunteers or staff assisting during the initial weeks.
- **Accessible instructions**: include video tutorials and/or simple step-by-step guides to ensure ease of understanding.

3. Motivational features and social connection

- **Goal setting and feedback**: allow participants to set personalized goals and provide regular feedback on progress. Timely, constructive feedback helps maintain engagement.
- **Social interaction and community engagement**: facilitate social features that foster a sense of community, which encourage engagement and reduce feelings of isolation. Intergenerational days or "adopt a grandparent" events whenever safely conducted could further enhance community ties.

4. Safety and privacy

- **Safety**: when organizing an event, create a safe and structured environment, remembering that older adults are more frail. Host the event in a secure, controlled location such as a community center, senior center, or other monitored venue. Place staff or trusted volunteers around the event area to supervise interactions, assist where needed, and ensure that older adults feel comfortable and safe throughout the event. Set clear guidelines on behavior, time limits, and boundaries for all participants to prevent any inappropriate interaction. Have a list of emergency contacts for each older adult participant, as well as first aid support on-site.
- **Privacy protections**: communicate clearly about data usage and ensure that personal data is handled securely. Address privacy concerns by offering features that allow users to control data-sharing settings.
- **User control**: allow participants to customize what data they share and with whom. Simplified security settings should also be prioritized.

5. Building motivation through real-life integration

- **Awareness of physical activity**: if you use an app, ensure that it provides visible metrics (like steps and activity time) to boost awareness and motivation for daily physical activity.
- **Routine encouragement**: include health reminders and tips tailored to the needs of older adults, such as hydration reminders or encouragement messages, to establish physical activity and a healthy lifestyle as a daily habit.

6. Cost-effectiveness and accessibility

- **Affordable participation**: keep the program low-cost or free to ensure access across socioeconomic levels.
- **Supportive funding or device lending**: consider providing resources for lending devices or subsidizing wi-fi internet access to overcome financial barriers.

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Appendix A1

FOCUS GROUP	Questions	Duration
Participants	▪ **Moderator** ▪ **(Second Moderator → Observer + Note taking)** ▪ **Community-dwelling older adults invited to the focus group by the municipality (max 7-8 per focus group)**	
Preparation	▪ **(Audio-recorder)** ▪ **Coffee/tea/milk and cookies or snacks** ▪ **(name tags)**	
Introductory part	▪ **Welcoming** ▪ **Introduction of the moderator(s)** ▪ **Short description of the topic and the project/intervention** ▪ **Introduction of the rules:** ○ **informed consent/other form of consent** ○ **(audio recording)** ○ **acknowledging diverse opinions** ▪ **Round of introductions** ○ **Name, age**	**5 – 10 min**
Transitory questions	What do you usually do in terms of PA? How often do you use apps on smartphones or tablets?	**5 – 10 min**
Main questions	**Focus on three areas of feasibility among the ones proposed by Bowen and colleagues (2009) [30].** **Acceptability of the Intervention** What is your experience with using apps and in general digital tools such as smartphones or tablets? And what is your experience with apps that focus on promoting health? (for example, to communicate with your doctor, or to help you with healthy habits, like physical activity or nutrition)? How comfortable do you feel about using an app on your mobile phone or tablet?	**30 – 40 min**

	What features would you like or not to see in an app that promotes healthy lifestyle/physical activity? How comfortable do you feel about an intervention that promotes healthy lifestyle/physical activity in older adults through a competition between European municipalities? What characteristics would you like or not to see in an intervention that promotes physical activity in community-dwelling older adults through a competition between European municipalities? What aspects of the EUAPPTIVE intervention as it was explained to you would you like or dislike? Do you know anyone (older adult) who would certainly not join this kind of intervention? Why/why not? **Practicality (barriers and facilitators)** Are there any practical factors (e.g., time, internet access, resources, privacy/security concerns) that might affect your ability or prevent you to use a smartphone-based app? Or anything that would facilitate your ability to use this app (e.g., technical assistance)? What about barriers and facilitators related to a smartphone-based app that aims at increasing physical activity? How do envision the EUAPPTIVE intervention fitting into the context of your local community? Are there any specific factors or considerations related to your city that should be taken into account when designing the intervention (e.g., accessibility of public facilities, and transportation options)? **Limited-Efficacy Testing** Would you be willing to participate in the EUAPPTIVE project? How successful do you think this intervention would be if implemented? What would you expect to happen to you/your health if you participate in this intervention?	

Closure	▪ Would you have any other specific recommendation or issue that wasn't discussed yet? ▪ Brief discussion with the participants to summarize the main point. ▪ Closing of the focus group, inform about next steps of the project, thanks, and farewells.	**5 – 15 min**