Co-Designing a Multidomain Digital Toolkit to Support Cognitive Health in the Aging Dutch Population: Schouderklopje

Nikita Sharma[1*], Frodo Muijzer[2], and G.D.S. Ludden[1]

[1] *Interaction Design (IxD) group, Faculty of Engineering Technology, University of Twente, Drienerlolaan 5, 7522 NB, Enschede, The Netherlands*

[2] *Biomedical Signals and Systems (BSS), Faculty of Electrical Engineering, Mathematics and Computer Science, University of Twente, Drienerlolaan 5, 7522 NB, Enschede, The Netherlands*

Abstract

The increasing prevalence of cognitive decline among older adults, coupled with the limited availability of accessible treatments, underscores the need for self-managed digital interventions to help mitigate the risk factors associated with cognitive decline. In that regard, this study explores the perceived challenges, motivations, needs, and key design features to inform the development of Schouderklopje, a user-centered, self-managed multidomain digital toolkit, from the perspective of domain experts. Challenges such as evolving and dynamic personal circumstances, limited awareness of brain health, and a lack of resources or support after the evaluation phase can affect the adoption of Schouderklopje. The motivation to adopt such lifestyle interventions was from a desire to improve overall health and social contribution. Furthermore, to ensure the toolkit is both self-managed and user-centered, importance of incorporating features supporting autonomy, personalization, education, skill development, and trustworthiness was noted.

Keywords
Digital toolkit, Brain health, Older adults, Design needs

1. Introduction

Declining cognitive health is a growing concern among older adults. Currently, dementia affects over 55 million people globally, with projections indicating that this number will triple to approximately 156 million by 2050 [1] [2]. Europe currently accounts for 17.78\% of this global total, with 9.78 million affected, and this figure is expected to double to 18.85 million by 2050 [3]. Despite the growing prevalence of dementia, there is no cure or widely accessible treatment available. As a result, the most effective and proactive approach to prevent cognitive decline is by reducing risk factors such as hypertension, diabetes, obesity, smoking, excessive alcohol consumption, physical inactivity, social isolation, and depression [4].

Research suggests that individual risk factors show a low to moderate association with cognitive decline [5]. The Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER) explored this approach by addressing multiple risk factors (diet, physical exercise, cognitive training, and vascular risk monitoring) through a multidomain

✉ n.sharma@utwente.nl (N. Sharma); f.muijzer@utwente.nl (F. Muijzer); g.d.s.ludden@utwente.nl (G. Ludden)

🆔 0000-0002-2803-9834 (N. Sharma); 0009-0007-2109-3444 (F. Muijzer); 0000-0003-4508-9865 (G. Ludden)

lifestyle intervention [6]. This intervention delivered to 1260 older adults at risk of cognitive decline over two years in a randomized controlled trial, demonstrated that improving multiple domains not only promotes a healthier lifestyle but also enhances the overall cognitive functioning [6].

Inspired by these results, the World-Wide FINGERS network involving over 35 countries from Europe, Africa, Japan, and Latin America was launched. This network aimed to explore adherence, effectiveness, implementation, and feasibility as well as to also validate FINGER findings across various countries and settings when similar multidomain lifestyle programs were presented. In MIND-AD RCT, multidomain lifestyle intervention had good feasibility and adherence when presented alone or combined with medical food in persons with prodromal Alzheimer's disease [7]. FINGER-NL trail (intervention focused on the Dutch population) was conducted with 1206 older adults at risk for cognitive decline for a duration of 24 months [8]. In this RCT, in addition to the domains introduced in FINGER, sleep management, stress and relaxation, social activities, and Souvenaid (a nutritional supplement) were presented to Dutch older adults at risk of cognitive decline. The obtained preliminary results highlight the significance of a multidomain approach among Dutch population.

Although a multidomain lifestyle intervention appears to be a proactive approach to reducing cognitive decline, it is important to note that these interventions were largely conducted with the support of domain experts, lifestyle coaches, and funding from research organizations. This reliance on structured programs (usually combination of online and offline) and external support limits the adoption of such interventions to the broader population, particularly when individuals are required to sustain these practices independently at home for longer durations [9] [10] [11]. One potential way to support independent at-home practice of the multidomain approach is through the development of a fully digital intervention.

In this context, we envision *Schouderklopje*—a self-managed, user-centered, multidomain digital lifestyle toolkit. Note that, S*chouderklopje* is a Dutch word that translates to "Pat on the back," symbolizing the idea of rewarding users when they take steps toward adopting a healthier lifestyle and seeing the digital support as the actor that supports making and sustaining any changes towards a healthy lifestyle. As a first step towards the development of *Schouderklopje* we aim to identify the needs of end users and highlight the key design features that should be integrated into the intervention. Additionally, considering the diverse experiences of older adults in adopting digital lifestyle interventions, we also aim to understand the potential challenges and motivations that may influence the adoption of such digital lifestyle interventions. To achieve this, we draw on the firsthand experiences of experts and lifestyle coaches involved in conducting or designing multidomain lifestyle intervention trials.

2. Methods

2.1 MOCIA Project and Study design

The MOCIA (Maintaining Optimal Cognitive functioning In Ageing) project comprised of four components, namely FINGER-NL, HELI, COMBI, and eHealth, each having different but complementary objectives [12]. FINGER-NL is a mix of online and offline multidomain lifestyle intervention providing information and trainings under expert supervision over the course of two-year to promote healthier lifestyles, followed by an evaluation of its effects on cognitive functioning in 1210 Dutch older adults (60-79 years) [8]. HELI is a 28-week adaptation of this

lifestyle intervention aimed at obtaining biomarkers to measure its impact on overall brain health [13]. COMBI focused on assessing the effects of a nutritional supplement designed to improve gut health, which in turn supports brain health, over 8 weeks [14]. In total, 102 and 75 Dutch older adults (60-75 years) participated in HELI and COMBI respectively. Lastly, the eHealth component aimed to develop and evaluate a multidomain digital lifestyle toolkit, while also exploring the behavioral impact of the intervention on Dutch older adults [15].

Dyadic and one-to-one interview sessions were conducted with experts and lifestyle coaches conducting or designing FINGER-NL, HELI, COMBI, and eHealth studies.

2.2 Participants and ethical consideration

Participants were recruited based on their involvement in studies within the MOCIA project. A total of fourteen experts—three lifestyle coaches, seven early-stage researchers, and four senior researchers participated in five dyadic and four one-to-one interview sessions [Table 1]. For dyadic interview sessions, they were grouped based on their roles in the different studies or their level of expertise. For example, two lifestyle coaches managing FINGER-NL trials were interviewed together, while early-stage researchers and senior researchers working or having expertise within the same domain were paired. Note that, the MOCIA project partners voluntarily participated in the study, and therefore an online informed consent was obtained from each participant prior to recording the interview sessions.

Table 1
Participants, their level of expertise and domains, and roles within the MOCIA project

P No.	Expert level	Role in MOCIA project	Related domain
P1 P2	Early-stage researcher Senior research	Conducted studies in eHealth	Sleep and Cognitive training
P3 and P4	Both senior researchers	Led FINGER – NL trail	All domains of FINGER-NL
P5 and P6	Both Lifestyle coaches	Conducted FINEGR-NL trail	All domains of FINGER
P7	Early-stage researcher	Supported FINEGR-NL trail	Physical Activity
P8 P9	Early-stage researcher Senior research	Conducted studies in eHealth	Stress and relaxation
P10	Early-stage researcher	Conducted studies in eHealth	All domains of FINGER-NL
P11	Lifestyle coach	Supported FINEGR-NL trail	Cognitive training and relaxation
P12	Early-stage researcher	Conducted studies in eHealth	eHealth
P13 and P14	Both Early-stage researchers	Conducted HELI and COMBI study	Diet and Nutrition domain

2.3 Materials

Semi-structured interview sessions having four main parts were conducted. In part I, experts were first asked to elaborate on their specific domain, its relevance to brain health, and the potential goals of integrating their respective domain into a digital lifestyle home toolkit. Part II, focused on the ongoing/completed studies, their outcomes, participant experiences, needs, and challenges. These insights were explored to understand how these might inform the development of the home toolkit. In part III, specific questions on the design features

requirement inspired by persuasive system design model for the overall toolkit and different modules were posed [16]. Key features discussed included self-monitoring, gamification, goal setting, rewards/praise, personalized monitoring and feedback, privacy, trust, autonomy, social connection/community building, and education.

2.4 Procedure

At the beginning of the interview session, experts were provided with an oral explanation about the vision of the digital lifestyle toolkit and aims of the session. Each interview session was customized to align with the specific domain expertise of the interviewee as the study involved experts from various domains. For instance, questions related to Diet and Nutrition were addressed with the respective expert. Each session lasted approximately 60 minutes.

2.5 Data Analysis

The interviews were transcribed verbatim, and the thematic analysis approach described by Braun and Clarke was used [17]. Transcripts were coded in 3 steps: open coding, axial (thematic) coding, and selective inductive coding for identifying challenges, motivations, and needs of Dutch older adults towards a self-managed multidomain digital toolkit to maintain optimal cognitive health. First, all the transcripts were read by the first author (NS), and useful relevant fragments were selected and initially coded. Then, open codes were examined and arranged into themes. Thereafter, the themes were discussed and validated within the broader research team. Design features were obtained with the help of both inductive and deductive coding. This is because some design features were discussed directly in the interview session (deductive approach), however, some of them also emerged as a translation to the obtained challenges, motivations, and needs (inductive approach). ATLAS.ti was used for these analyses [18].

3. Results

This section first presents the needs (Table 2) and key design features (Table 3) identified for informing the development of Schouderklopje. Thereafter, themes identified under possible challenges and motivations for adopting such digital lifestyle interventions are presented.

3.1 Needs for informing the development of Schouderklopje

3.1.1 Multidomain self-management digital toolkit

Experts identified the six domains namely diet and nutrition, physical activity, cognitive training, sleep management, stress and relaxation, and social engagement essential for the toolkit. However, they emphasized that each domain requires different levels of monitoring (passively tracking specific metrics or behaviors over time to gather data and assess progress), training (an active process that focuses on developing skills, knowledge, or abilities through instruction and practice to improve performance), and coaching (a personalized and interactive approach that provides support, guidance, and feedback to help individuals achieve their goals).

According to the experts, users can be monitored, trained, and coached on diet & nutrition and physical activity domains. These domains were also of high interest to users, as they could see tangible outcomes for their efforts (for example, weight loss). Moreover, in these domains,

users were found more open in sharing personal information in exchange for tailored guidance and feedback to help them improve in these areas.

Among all the domains, cognitive training is one that users appeared to make a direct association with brain health. Users perceived cognitive training scores as indicators of their brain health. However, some users reported feelings of repetitiveness in cognitive training exercises before advancing to the next level. To enhance user engagement, cognitive training exercises can be customized based on the previous cognitive training scores, thus necessitating monitoring and training for this domain.

Table 2
Identified needs for informing the development of Schouderklopje

Need	Description
Multidomain self-management digital toolkit	Six domains namely Diet and nutrition, Physical activity, Cognitive training, Sleep management, Stress and relaxation, and Social engagement were deemed useful for implementing in the toolkit. Depending on the domain and user preferences these domains can have different level of monitoring, training, and coaching capabilities.
Involvement of family/partner	Involving family members or partners in the areas of diet, nutrition, and physical activity can boost motivation, willingness, and adherence to healthier lifestyle choices. However, when for stress and sleep management, users may prefer a more individual approach, valuing autonomy and privacy.
Skill development and brain health education	Users should learn from the toolkit but after some time they should be able to implement the learning in their daily life without requiring active assistance from the toolkit. Skill development can be supported by providing brain health education by using psychological, micro, and visual elements
Personalization	Experts emphasized the importance of continuously providing personalized monitoring, training, and feedback to enable participants to achieve their individual goals and adopt health habits.
User Experience and Interactions	Experts offered several suggestions to enhance the user experience, including the development of a centralized platform, flexible interaction rather than time-bound, and engaging content.

Domains such as sleep management and stress & relaxation were found to require only passive training due to the personal nature of sleep and stress data. Experts suggested that users were often hesitant to share information in these areas and believed that they might not require help in these areas. This notion may stem from a lack of awareness about the significance of these domains in promoting brain health.

"For the development of the digital toolkit, I would say that people click on I want to cope with stress (express interest), then we can provide something (training) that helps them with the stress. But I wouldn't measure it in any way, as it is a personal thing." [P8]

According to experts, social engagement domain presents unique implementation challenges because it is highly subjective to individual users' needs and preferences. For instance, users with limited social contact expressed a preference for features fostering connection, while those with robust social networks found it less appealing. To address these diverse needs, a (semi)-social engagement approach can be adopted. This would aim to foster meaningful connections while maintaining user privacy by enabling manual connections with close-knit groups, such as family, friends, or neighbors. Additionally, this domain could encourage participation in outdoor and community activities by offering relevant information and empowering users to organize or host such events, such as health clubs, physical exercise groups, or meditation sessions.

"Some people really like it (social engagement) and some don't. Some people said, I am already very social in my personal life, so in this study, I don't need that, but some people like it and want to have some more connection. So yeah, it is different." [P5]

3.1.2 Involvement of family/partner

Experts emphasized that such a digital home toolkit should consider the involvement of family members or partners, as they can significantly influence user behavior, both positively and negatively. For domains like diet and nutrition or physical activity, where users often rely on or make collective decisions with their family or partner, experts observed variations in motivation, willingness, and adherence to healthier lifestyle choices. Conversely, for domains such as stress management and sleep management, users preferred a more individualistic approach, valuing personal autonomy and privacy in these areas.

"To practice diet on their own is difficult. If they (participants) are living together, then they are cooking meals together, and if the partner says no, I don't want to do it, then it becomes difficult. And the other way around is true as well, that if one of the two partners is involved in the study, and the other partner supports it, and just goes along with the diet, and also feels good about it. That helps, motivates, and supports participants to go through such a program." [P7]

3.1.3 Skill development and brain health education

Usually in self-management applications, users are expected to use the applications continuously to practice a certain behavior. However, the involved experts in this study suggested an approach based on skill development such that users learn from the proposed toolkit, but after some time they practice or implement the learning in their daily life without requiring active assistance from the toolkit.

"I think the toolkit should focus more on teaching them the skills to cope with stress (in the stress domain), without requiring them to listen to the audio all the time. So our main idea is to help them learn something from the toolkit that they can then practice or implement into their daily lives without needing to open the app constantly." [P9]

Skill development can also be supported through education, as several experts highlighted a lack of awareness about brain health and its interconnectedness with various lifestyle domains. To cope up with this, experts suggest promoting brain and domain-specific education in the toolkit. Education can be delivered by using psychological, micro, and visual elements across the toolkit from credible sources to keep it engaging for users. Moreover, the information should also be tailored according to the knowledge level of the users.

"Education should be provided in a simple and fun manner such that people want to come back to it, otherwise you lose them in the first two weeks." [P4]

"They should not be any longer texts only micro teaching elements. Something you can read in one or two minutes." [P3]

3.1.4 Personalization

Personalization i.e., tailoring content, features, and the overall user experience of the toolkit to align with individual needs, preferences, and circumstances, appeared as a key concept in developing various elements of the toolkit to support users in their unique lifestyle adoption

journey. Lifestyle coaches emphasized the importance of continuously providing personalized monitoring, training, and feedback to enable participants to achieve their individual goals.

"You need to guide them to implement healthy habits. It takes time, and it's not possible to do everything at once. You have to help them figure out where to start? What is easy for them to change? What is their bigger goal, and how do we work toward that in coming years? I believe keeping it personal is an important part of the process." [P6]}

To enable personalized monitoring, a clear need for adaptive goal-setting that considers the dynamic and evolving lifestyle changes of the users also emerged. One of the lifestyle coaches from the FINGER-NL trial emphasized the importance of designing goals that are inspired by the personal interests of the users. Another coach, who helped participants in the FINGER-NL trial with setting and adjusting goals (initially and every three months based on progress), suggested that tracking and continuously adapting goals over time effectively stimulates, motivates, and serves as a reminder to keep practicing. This approach ensures the process remains manageable and does not become overwhelming. In the long term, adaptive goal-setting may also contribute to sustainable behavior change.

"It is not feasible to do the same goal for everyone because someone can walk 1 kilometer and someone runs 10 kilometres a day. I try to ensure that goals have a personal connection to the individual's interests. For example, in the domain of physical activity, some people might want to play with their grandchildren, so I would incorporate that into their movement goals." [P11]

For personalized training, experts emphasized that not all users need to practice all domains with the same intensity, as they may have prior experience in some areas while requiring more effort in others. Therefore, users should be allowed to choose which domains they want to focus on. Additionally, within each domain, they should have the flexibility to adjust the intensity of the program according to their needs.

"I can imagine there could be a personalization factor there because some people want to choose which domain they want to practice at first and then later they can change into some other domain. We also tried to make personal adjustments based on their wishes." [P4]

Furthermore, one of the eHealth experts who interviewed the participants of FINGER-NL trial indicated that participants looked forward to their personal measurement and feedback on how they performed so far in the intervention. It motivated them to be on the right track. Another eHealth expert emphasized the importance of carefully considering the type of feedback - whether evaluative (e.g., good, bad, excellent) or informative (e.g., raw data) — specifically when providing digital feedback. This is because some individuals may interpret evaluative feedback negatively, while informative feedback might be difficult to interpret. Therefore, a more neutral feedback approach combined with relevant information, may be used to deliver feedback. Overall, by taking a personalized approach, not only adherence but also the effectiveness of such interventions can also be enhanced.

"One person in focus group felt judged by the way technology provided feedback. The person was saying technology should not judge me, but the other person countered that it is not judging, it is giving you feedback or advice. So, it could be beneficial, but then you need to take a more neutral approach." [P9]

3.1.5 User experience and interactions

The experts provided several suggestions to enhance the user experience and interaction of the users with the platform, including presentation, content structure, and visual design. One of the

challenges in the FINGER-NL trial that affected participants' experience was the absence of a centralized platform. In the FINGER-NL trial, participants were directed to various online and offline resources and sessions to practice different domains and to foster engagement within their groups. For instance, one application was used for cognitive training, while the other application was used for tracking physical activities. Given the target user group, i.e., older adults, many participants found it challenging to learn how to operate different applications, remember passwords, and transition seamlessly between platforms.

To avoid this issue in the digital toolkit, experts suggested keeping all the content related to the various domains within the toolkit itself, allowing participants to access and engage with the material more easily and effectively. Additionally, experts emphasized the importance of incorporating features that facilitate mass communication, such as video calls and group chat functionalities, to encourage social interaction among participants in similar studies.

"If everything had been in the same dashboard, like the content from other apps, it would have been easier for the participants, but it wasn't possible to integrate it all within the dashboard. There were a lot of other features we wanted to implement, but many of them weren't feasible—for example, a group chat function for social interaction between participants or calling within the platform. Instead, we had to rely on Zoom or Teams. So there were some hiccups that definitely affected adherence to the intervention." [P4]

Furthermore, lifestyle coaches highlighted the time-bound nature of these interventions as one of the key concerns as it offers limited flexibility for users. This rigidity can result in cognitive overload, particularly if users miss tasks due to factors such as illness or vacations.

"They keep on getting the tasks in the online platform even if they go on vacation for two or three weeks. So, when they open the app after vacation, they have a lot of tasks and they are like, 'Oh my God.' You have to stay updated with the schedule; otherwise, it is like a buildup of information, and it is overwhelming." [P5]

Regarding content, experts emphasized the need to strike a balance between creating engaging material and maintaining scientific integrity, i.e., avoiding overstatements about the evidence. They also stressed the importance of carefully crafting the tone of instructions, suggestions, and feedback, especially in sensitive areas like sleep and stress management. Authoritative statements can make users feel as though the technology is dictating their life decisions, leading to a perceived loss of autonomy. Lastly, experts underscored the importance of making the digital toolkit simple, accessible, and tailored to the unique needs of its users.

"What is also challenging is how to use engaging language to encourage people to use the app while also being scientifically responsible and not overstating the evidence. For example, saying, 'By using this tool, you will reduce your dementia risk'—that's just not true." [P3]

3.2 Design Features

Design features for the development of the toolkit were elicited in two ways: by directly translating the expressed needs and by deductively deriving them from expert interviews (Table 3). The identified needs such as multidomain intervention leads to development of six individual domains; involvement of family/partner leads to development of (semi)-social connection feature; skill development and education leads to development of psyco, mirco, and visual educational elements; personalization leads to integration of adaptive goal setting, personalized training, and personalized feedback; user experience and interaction leads to pause-restart feature for flexibility and system credibility feature for providing scientific yet engaging

information. It should be noted that the implementation of these identified features might vary across domains.

Table 3

Design feature for developing Schouderklopje

Feature	Description
Design features translated from needs	
Six domains	Diet and nutrition, Physical activity, Cognitive training, Sleep management, Stress and relaxation, and Social engagement.
(semi)-social connection	To allow user to connect with partner/family in domains such as Diet and nutrition and Physical activity. This feature can also be extended for connecting to social circles depending on user preferences.
Psyco, mirco, and visual educational elements	Brain health education and importance of multiple domains in improving brain health can be provided with the help of psychological, micro, and visual educational elements.
Adaptive goal setting	Adaptive goal setting feature will be integrated to allow user to set their own goals based on their personal circumstance, needs, and capabilities. This approach ensures the process remains manageable and does not become overwhelming
Personalized training, and feedback	Users should be allowed to choose the domains they wish to focus on as not all users need to engage with every domain in the same intensity. Additionally, providing personalized feedback can motivate users in staying on the right track.
Pause - restart	The toolkit should offer flexibility in terms of time if user needs to pause or restart the intervention due to external factors such as illness or vacations.
System credibility	As education in the toolkit will be provided based on scientific knowledge, users should be able to verify the resources and people involved in development of the toolkit.
Design features derived deductively from expert interviews	
Real-time progress overview and progress reports	Toolkit should provide an option to keep track of real-time progress and provide weekly progress. These can be provided through visualization that are easily understandable by the older adults.
Praise [16]	Praise was seen as appropriate and valuable, serving both as a motivational booster and a form of constructive feedback for users.
Trust and privacy [16]	Trust among the users can be built by using educational materials from credible sources. To ensure privacy, users should be explicitly informed about the types of data collection, analysis, and storage process.
Autonomy [19]	Autonomy appeared as a key experiential design feature that should be maintained throughout the toolkit.

Apart from these features, some other features such as self-monitoring, gamification, rewards and praise, privacy, trust, reliability, and autonomy were discussed explicitly with the experts. Design feature self-monitoring aligns with the self-managed nature of the toolkit as well as identified adaptive goal setting feature. Experts emphasized leveraging this feature to empower users to take control of their health by identifying trends, setting goals, and making informed decisions to improve their lifestyle. To support self-monitoring, along with adaptive goal setting, a real-time progress overview and weekly progress reports will be integrated into various domains of the toolkit.

A mixed response regarding the gamification feature was observed from the experts. While some users may find motivation in challenges presented through gamified elements, others may dislike the competitive aspect. To address this, experts suggested making the gamification feature optional, allowing interested users to participate while accommodating those who prefer not to engage. Particularly, experts saw the benefits of gamification in the cognitive training domain as their participants usually get bored of the same exercises, and by using the game approach the engagement can be maintained.

"I would present gamification as an option, offering a challenge to participate in. For example, "Do you want to join the challenge, or would you rather practice on your own?" Those motivated by challenges often appreciate the opportunity to join, while others may prefer to decide for themselves not to participate. Some people might try it out for a week and then decide, "No, this isn't for me," or, "Yes, I'd like to join the next challenge." [P10]

Virtual rewards, such as trophies or medals, were considered less effective for the given population and topic. They were perceived as lacking seriousness. However, praise was seen as appropriate and valuable, serving both as a motivational booster and a form of constructive feedback for users.

"A few people enjoy it, but only for fun. One of the apps they use includes features like earning medals and stars. However, this approach feels somewhat westernized, and while some individuals appreciate it, many are sensitive to it, with others finding it irritating." [P6]}

"I think it is good to let them know or give them feedback that they are on the right track. Most of the participants are older people who also don't like the childish idea of being given a medal or something like a virtual medal." [P10]

In the FINGER-NL trial, experts provided continuous interaction and guidance, which fostered privacy and trust in the intervention among participants. However, such direct guidance will not be available in the digital toolkit. To address this, experts recommended building trust by using educational materials from credible sources. To realize this, educational videos for various domains will be created by experts affiliated with educational or research institutions, and additional materials, such as tips and exercises, will be sourced from trusted resources. For privacy, experts suggested informing users about the types of data collected, how it will be used for their benefit, and where it will be stored. This will be achieved by providing clear, transparent instructions and obtaining explicit consent to ensure user confidence in the toolkit's data practices.

"Sometimes, reading the developer's terms (on privacy) can help reassure them. I believe the most important part is showing that the developer has thoroughly considered privacy-related issues." [P7]

Autonomy emerged as a key experiential design feature that should be maintained throughout the toolkit. Experts emphasized that while a basic structure helps users stay focused within the intervention, they should have the freedom to determine what works best for them by exploring the toolkit and tailoring it to their needs. For example, users will be invited to explore and select the domains they wish to work on at their own pace.

"People should genuinely feel that they have the freedom to make their own choices, rather than being forced toward something." [P9]

"I think providing a baseline structure of the program helps them get started, and from there, they can do a lot on their own." [P11]

3.3 Challenges in the adoption of digital lifestyle toolkit

3.3.1 Personal choices and circumstances

It was observed that not every participant approaches each domain with the same level of enthusiasm. This stems from the fact that not everyone needs to improve in every domain, or they may simply not prioritize certain aspects of the intervention. For example, if a person does not experience any sleep problems, they may be less motivated to work on that particular area.

Furthermore, because of the requirement of a long-term commitment (two-year study), personal circumstances such as changes in their own life, or the lives of their partners/family members can also impact adherence to the lifestyle intervention.

"It is a long study. So, a lot can happen in two years in personal life, maybe they get sick, or their partner gets sick, so they have to take care of them." [P11]

Retirement is one example of an evolving personal circumstance that can influence lifestyle of older adults. It has been observed that retired older adults often lose the overall structure of their day, leading to decreased physical and social activity, irregular eating habits, and disrupted sleep patterns. For example, they may go without leaving the house for several days, prefer to eat at irregular intervals, or indulge in late-night television viewing, as they no longer have the obligation to maintain a structured day. In such situations, it becomes challenging to encourage them to adopt healthier lifestyle changes or practice different domains systematically.

3.3.2 Lack of education on brain health

Assessing brain health is challenging due to the absence of directly observable parameters like blood pressure, step count, etc. Experts noted that FINGER-NL participants often struggled to recognize the direct impact of some activities or domains they were practicing on their health. For example, improvements in physical measurements, such as waist size and weight, were easily observable with a healthy diet and physical activity. Similarly, the benefits of cognitive training were immediately evident through improved scores at the end of exercises. However, practices related to sleep management lacked immediate and tangible results, leading to demotivation and, at times, frustration among participants. Therefore, education is considered vital for highlighting the importance of different domains in brain health and for motivating users to engage with all domains consistently.

"If I think from their (participant's) side, it is also really hard to connect with brain health because you cannot see brain health like you can see blood pressure. You can see the fact that you can walk a longer distance or that you can lift up your grandson. Therefore, if I think about toolkit, then education on brain health should be the focus." [P10]

3.3.3 Limited availability of resources

It was observed that the majority of participants who experienced positive outcomes in the FINGER-NL trials were inclined to adhere to the healthy lifestyle they had adopted in the trial. While they can continue practicing domains for which they have developed knowledge and skills, such as physical activities and diet, they expressed concerns about the end of support and resources provided during the study period for other domains. For instance, they received personalized support from lifestyle coaches to identify and achieve their health goals. Additionally, support from their peers helped them maintain motivation throughout the study. Furthermore, they received a health supplement (Souvenaid) and subscriptions to lifestyle applications free of charge. With the conclusion of such studies, these resources also end, potentially leading to dropouts and affecting the sustained implementation of a healthy lifestyle among the participants despite their willingness.

"They can continue with the diet and physical activities, but some applications are no longer accessible after the study, and Souvenaid is also unavailable. As a result, these domains will no longer be part of their routine, which participants sometimes find challenging. They ask, "How can

I continue if these resources are no longer available?" Therefore, they need to find alternative ways to maintain these aspects of the lifestyle if they wish to continue." [P5]

3.4 Motivation for adopting a digital lifestyle intervention

3.4.1 Willingness to improve overall health

According to the involved experts and lifestyle coaches, the majority of the participants participated in the studies because of the fear of getting cognitive decline in the future as they have witnessed the impact of cognitive decline in their close family.

"I believe fear is a significant motivator, as many participants have close family members such as siblings or parents who have been affected by dementia or Alzheimer's. This often creates a sense of anxiety, as they worry they might develop the condition as well or they may be at a higher risk." [P6]

In addition to the stated benefit of the possibility of reducing the risk of cognitive decline, some participants in the FINGER-NL trial were also incentivized by the prospect of improving their overall health by reducing sedentary behavior. Furthermore, participants were observed to adopt a healthy lifestyle if they require only some minor modifications in their current lifestyle. But if they put tremendous efforts, they expect some visible positive outcomes to continue with it. It was also anticipated that the skills participants learned during the trial might help them in picking up the healthy lifestyle much easier in case they do not follow it after the trial, or at least they will be able to identify the symptoms of early cognitive decline.

"I think they participated to improve their lifestyle, so also be more physically active and reduce sedentary behavior and hopefully reduce dementia or cognitive decline." [P7]

"Some participants for the dietary choices, they did not have to change a lot. So, it is very easy. They change a little bit and go on with their life. Those who change very much depend on how much they see the results from it. So, I have one participant that comes to mind. She changed a lot in her dietary intake and her husband as well. But she also sees a lot of health benefits and positive health changes. So, she is really enthusiastic to continue this lifestyle." [P6]

3.4.1 Social contribution

There were also a significant number of participants who were motivated to join the trial to contribute to broader societal benefits, particularly for the well-being of future generations.

"Some of them just want to contribute to research. They may have a family member with dementia or something like that. They just want to see in the future that it is getting better for their kids, for their grandchildren." [P5]

4. Discussion

In this section, we extend the discussion on the obtained findings in two main aspects: design needs for the development of digital lifestyle intervention and possible challenges and motivation in adopting digital lifestyle intervention.

4.1 Design needs for the development of digital lifestyle intervention

Schouderklopje is envisioned as a user-centered, self-managed, multi-domain digital lifestyle intervention designed to promote brain health among the older adults while aligning with their values regarding health and digital technology. The multidomain nature of this toolkit makes it unique and effective for optimizing cognitive decline [6] [8], however the varying levels of monitoring, training, and coaching in each domain must be accounted. Identified design features such as skill development and education with the help of psychological, micro and visual elements can promote the competence, usefulness [20], and health outcomes [21] [22]. Although the educational interventions on brain health and their potential impact on users are limited [23][24], both education and skill development emerged as crucial factors in the development of self-managed tools. Other persuasive design features such as adaptive goal setting [25] and personalized monitoring, training, and feedback [16] [26] can be implemented in the toolkit to enhance the autonomy among older adults. In the previous works it is found that goal setting in combination with progress feedback, can motivate older adults toward sustainable behavior change. However, the goals need to be aligned with the user's personal circumstances and needs—that is, they should be adaptive in nature [27].

Furthermore, to ensure a user-centric approach, the toolkit should be tailored specifically to the target population, i.e., older adults [28]. It should feature a simple and engaging design [29] with all necessary resources easily accessible within the toolkit. A sense of autonomy was also demanded from such interventions [30], as many older adults prefer to make their own decisions about their health, rather than being directed by the digital agents. The toolkit should prioritize building trust by involving experts and utilizing credible resources [31] [32]. Lastly, it is important to note that this work primarily focused on gathering insights from the firsthand experiences of experts as a starting point. The identified needs and design features will be further validated with end-users by actively involving them in the future design process.

4.2 Possible challenges and motivation in adopting digital lifestyle intervention

Challenges related to the adoption and sustained engagement in digital lifestyle intervention can arise from personal circumstances and individual user preferences [26], lack of brain health education and limited support and resources for long-term impact the uptake of digital health interventions. These identified challenges are in-line with the existing works where factors such as lack of personalization, knowledge and skill, and poor user experience were often identified as barriers in using digital health interventions [22] [33] [34] [35].

Motivation to adopt the toolkit may arise from various intrinsic and extrinsic factors, such as a general willingness to improve overall health and well-being and desire to make a positive societal contribution. In addition to these self-driven motivations, social support—particularly from friends, family, and healthcare professionals—plays a crucial role in encouraging the use of digital lifestyle interventions [20]. While intrinsic motivation fosters a sense of autonomy and relevance, external support can reinforce feelings of competence and relatedness [36]. These challenges and motivational factors should be considered and integrated into the development process of *Schouderklopje* to ensure its relevance, accessibility, and long-term engagement among older adults [37].

5. Conclusion

In conclusion, this study offers valuable insights into the needs, key design features, perceived challenges, and motivations for the development and adoption of Schouderklopje, from the perspective of the experts. Findings emphasize the significance of education and skill development for allowing sustainable lifestyle adoption, personalization for creating interventions that align with individual goals, preferences, and circumstances, and autonomy to allow users in making their own decisions about their health. Additionally, a user-centric approach that prioritizes simplicity, accessibility, and trustworthiness is crucial for encouraging the sustained use of the toolkit. Lastly, the obtained findings from this study can also be extended for the development of similar self-managed ehealth or digital health interventions.

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