

Impact of a mobile health application on digital transformation: a randomized clinical trial on strengthening digital skills in older women

Laura Thais Del Vecchio Sampaio, Carlos Júnior, Andressa Sobrinho, Grace Gomes

Submitted to: JMIR Formative Research
on: April 29, 2025

Disclaimer: © The authors. All rights reserved. This is a privileged document currently under peer-review/community review. Authors have provided JMIR Publications with an exclusive license to publish this preprint on its website for review purposes only. While the final peer-reviewed paper may be licensed under a CC BY license on publication, at this stage authors and publisher expressly prohibit redistribution of this draft paper other than for review purposes.

Table of Contents

Original Manuscript..... 5

Supplementary Files..... 20

0..... 20

0..... 20

0..... 20

CONSORT (or other) checklists..... 21

CONSORT (or other) checklist 0..... 21

Impact of a mobile health application on digital transformation: a randomized clinical trial on strengthening digital skills in older women

Laura Thais Del Vecchio Sampaio¹; Carlos Júnior^{2, 2}; Andressa Sobrinho²; Grace Gomes³

¹ Sampaio Universidade Federal de São Carlos SÃO CARLOS BR

² Universidade de São Paulo RIBEIRÃO PRETO BR

³ Universidade Federal de São Carlos SÃO CARLOS BR

Corresponding Author:

Laura Thais Del Vecchio Sampaio

Sampaio

Universidade Federal de São Carlos

Rodovia Washington Luís 310

SÃO CARLOS

BR

Abstract

Background: Digital technology advanced rapidly following the COVID-19 pandemic; however, older adults continue to face significant challenges in adopting and effectively using these technologies. Mobile health applications offer a promising strategy to enhance digital competencies and promote digital inclusion among this population.

Objective: This study aimed to evaluate the impact of a lifestyle-oriented mobile health application on improving digital skills, as well as to assess its usability and the level of user satisfaction among older women.

Methods: A 14-week randomized clinical trial was conducted in Ribeirão Preto, São Paulo, Brazil. Forty elderly women were randomized into an intervention group (n = 21), who used the mobile application, and a control group (n = 19). Digital competencies were measured before and after the intervention using a semi-structured questionnaire based on the MCDMSenior framework, covering six domains: basic technology use, internet navigation, mobile application use, online research, digital communication, and utilization of digital resources. Additionally, satisfaction with the educational content was evaluated using the Suitability Assessment of Materials (SAM) and system usability was assessed using the System Usability Scale (SUS). Qualitative data regarding participant experiences were also collected.

Results: Post-intervention analyses revealed significant differences in specific digital competencies. The intervention group demonstrated a moderate improvement in internet navigation skills (Cohen's d = 0.634), while gains in basic technology use and digital communication were minimal. Conversely, the control group exhibited moderate improvement in basic technology skills (Cohen's d = 0.521) and lower effects in online research and digital communication. Overall, satisfaction with the educational content was low (average SAM = 35%), and usability was rated as average (SUS = 71.5 points). Qualitative feedback underscored persistent age-related fears and insecurities in the use of digital technologies.

Conclusions: Mobile health applications can effectively enhance certain digital competencies in older women, particularly internet navigation, but improvements in content suitability and usability are needed. Refinements in application design and tailored user support are essential to overcome age-related barriers and foster digital inclusion among older populations. Clinical Trial: Brazilian Registry of Clinical Trials (ReBEC), Registration No. RBR-6wgkzs8.

(JMIR Preprints 29/04/2025:76725)

DOI: <https://doi.org/10.2196/preprints.76725>

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

✓ Please make my preprint PDF available to anyone at any time (recommended).

Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.
Only make the preprint title and abstract visible.

No, I do not wish to publish my submitted manuscript as a preprint.

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**

Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain visible to all users.

Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in <http://www.jmir.org/>

No. Please do not make my accepted manuscript PDF available to anyone. I understand that if I later pay to participate in <https://www.jmir.org/>



Original Manuscript

Title: Impact of a mobile health application on digital transformation: a randomized clinical trial on strengthening digital skills in older women

Abstract

Background: Digital technology advanced rapidly following the COVID-19 pandemic; however, older adults continue to face significant challenges in adopting and effectively using these technologies. Mobile health applications offer a promising strategy to enhance digital competencies and promote digital inclusion among this population. **Objective:** This study aimed to evaluate the impact of a lifestyle-oriented mobile health application on improving digital skills, as well as to assess its usability and the level of user satisfaction among older women. **Methods:** A 14-week randomized clinical trial was conducted in Ribeirão Preto, São Paulo, Brazil. Forty elderly women were randomized into an intervention group ($n = 21$), who used the mobile application, and a control group ($n = 19$). Digital competencies were measured before and after the intervention using a semi-structured questionnaire based on the MCDMSenior framework, covering six domains: basic technology use, internet navigation, mobile application use, online research, digital communication, and utilization of digital resources. Additionally, satisfaction with the educational content was evaluated using the Suitability Assessment of Materials (SAM) and system usability was assessed using the System Usability Scale (SUS). Qualitative data regarding participant experiences were also collected. **Results:** Post-intervention analyses revealed significant differences in specific digital competencies. The intervention group demonstrated a moderate improvement in internet navigation skills (Cohen's $d = 0.634$), while gains in basic technology use and digital communication were minimal. Conversely, the control group exhibited moderate improvement in basic technology skills (Cohen's $d = 0.521$) and lower effects in online research and digital communication. Overall, satisfaction with the educational content was low (average SAM = 35%), and usability was rated as average (SUS = 71.5 points). Qualitative feedback underscored persistent age-related fears and insecurities in the use of digital technologies. **Conclusions:** Mobile health applications can effectively enhance certain digital competencies in older women, particularly internet navigation, but improvements in content suitability and usability are needed. Refinements in application design and tailored user support are essential to overcome age-related barriers and foster digital inclusion among older populations. **Trial Registration:** Brazilian Registry of Clinical Trials (ReBEC), Registration No. RBR-6wgkzs8.

Keywords: competencies, elderly people, gerontology, intervention, lifestyle habit.

1. Introduction

The COVID-19 pandemic has accelerated the adoption of digital technologies, condensing three years of progress into just one.¹ This rapid advancement has brought significant challenges and opportunities for the elderly population.² Increased social isolation has increased the risk of physical and cognitive decline among older adults,^{3,4} driving the integration of health technologies.⁵

Evidence shows that in 2018, 10% of the population aged between 50 and 80 used health and well-being apps, which increased to 28% in 2020.⁶ This increase indicates a greater acceptance of telehealth among the elderly, highlighting the potential for expansion of these services.⁷ Therefore, it is crucial to continue advancing digital integration efforts to ensure that older adults can benefit from these services.⁸

Despite these advances, the elderly population still faces significant barriers in adopting digital technologies. Studies by Fowe et al. (2023) and Tuena et al. (2020) highlight previous experience, digital exclusion, cognitive and motivational barriers.^{9,10} Other critical obstacles are usability and user satisfaction, which affect digital adoption among seniors.¹¹ Therefore, it is essential to address these barriers with targeted interventions and support to overcome the digital divide and facilitate older adults' engagement with digital skills.^{11,12,13}

Digital competencies are defined as skills, knowledge, and attitudes crucial to the effective use of digital technologies, from basic device operation to evaluating and communicating online content,¹⁴ benefiting the health and well-being of the elderly population.¹⁵ Consequently, improved skills are associated with increased use of telehealth, highlighting the importance of addressing disparities in access and health outcomes by enhancing users' digital skills and confidence.¹⁶

Thus, this research specifically investigates how a mobile application that promotes lifestyle habits can improve digital skills in the elderly, in addition to analyzing usability and user satisfaction.

2. Method

2.1. Type of study

This project is a fragment of a larger research project, the objective of which is to develop and validate a multidisciplinary application to promote changes in lifestyle habits, with simple guidelines, according to the daily demands of each elderly person. The research is a randomized clinical trial, with a 14-week intervention. Participants were randomly assigned to two groups: the application group and the control group. The best details of the application steps can be read in an article developed by Sobrinho and his collaborators (2024).¹⁷

This fragment of the study was developed as an exploratory research analysis of clinical trial data and collection of qualitative data.

2.2. Location, period, and participants

The research was carried out in elderly people living in the city of Ribeirão Preto, in the interior of the state of São Paulo, Brazil. It was carried out between July and December 2023. This randomized clinical study followed the guidelines of the Consolidated Standards of Reporting Trials (CONSORT).¹⁸ In Figure 1, shows the participant recruitment flowchart.

Figure 1

The inclusion criteria were elderly individuals aged 60 or over who had a mobile device that supported the use of the application and its features. The exclusion criteria included limitations in carrying out the assessments included in the project, such as visual and auditory limitations and severe cognitive impairments, assessed by the Montreal Cognitive Assessment (MoCA) instrument.¹⁹

The sample size of causes and effects with a minimum sample size of 34 people was calculated using the G*Power 3.1 software, using ANOVA for inter-intragroup interaction with the following input parameters: effect size of 0.25; type I error equal to 0.05; type II error equal to 0.80; and number of groups equal to 2 and number of measurements equal to 2. A standard correlation between the measurements of 0.50 and a dropout rate of 20% were also used to account for possible sample losses, equivalent to $n=27$.

The use of an effect size of 0.25 was based on a similar study conducted by Lacroix et al.,²⁰ which investigated the effects of using a minimally supervised app in community-dwelling older adults compared to an unsupervised model.

2.3. Research development

At the beginning of the intervention, a detailed meeting was held to introduce the application, explore its functionalities and clarify operational doubts. During the first week, the researchers

maintained daily contact with the intervention group, offering ongoing support to facilitate familiarization with the mobile application. The frequency of contact was adjusted to every other day in the second week and subsequently to biweekly intervals, aiming to reduce technical difficulties and assess independent adherence to the application interface.

This monitoring strategy was designed to overcome barriers to use due to digital limitations and to monitor genuine participant adherence. The effectiveness of the intervention was measured through questionnaires and direct observations, focusing on changes in users' digital skills and satisfaction with the app's usability and content.

2.4. Instruments

To meet the objectives of this study, several data collection instruments were used. The questionnaires covered many aspects, including sociodemographic characteristics, digital skills, economic classification, material satisfaction and usability assessment.

An anamnesis script was prepared to accompany the questionnaires, aiming to obtain data on the participants' sex, date of birth and years of education. The Brazilian Economic Classification Criteria (CCBE) was used to categorize Brazilian families into economic classes (A, B, C, D and E).²¹

A semi-structured questionnaire based on the MCDMSênior was applied to assess the impact on improving the digital skills of the participants, separated into skills: 1) basic knowledge of technology, 2) internet navigation skills, 3) use of mobile applications, 4) ability to conduct online research, 5) digital communication, and 6) use of digital resources.¹⁴

The responses were scored from 1 to 3, where: 1 indicated that the elderly person was able to perform the skill without difficulty in handling; 2 indicated that they were able to perform the skill, but with difficulty in handling; and 3 showed that they were unable to perform the skill.¹⁴

Satisfaction with the application content was assessed by the Suitability Assessment of Materials (SAM), which makes it possible to assess the target audience's understanding of the educational material.^{22,23} Finally, user experience with digital health technology was assessed using the System Usability Scale (SUS), a tool that measures elderly user usability.^{24,25}

2.5. Ethics statement

The study follows the Declaration of Helsinki Principles. The research was ethically approved (CAAE), no. 58433922.0.0000.5659, registered in the Brazilian Registry of Clinical Trials (ReBEC), registration RBR-6wgkzs8, and in the Research Ethics Committee of the University of São Paulo (USP), registration no. 5.725.081. The participants signed the Free and Informed Consent Form (FICF), being informed about the research, its minimal risks and their rights, including the option to withdraw without consequences.

2.6. Statistical analysis

Data were processed and analyzed using IBM SPSS Statistics 25.0 and Microsoft Excel 2019. For a complete view of the data, measures of central tendency and dispersion, such as mean and standard deviation (SD), were calculated, as well as representations in percentage values. Initial similarity between groups was analyzed with Student's t-test for socioeconomic variables, years of education, and age.

An intention-to-treat analysis was performed using up to 5-level multiple imputations to address missing data and preserve the intention-to-treat (ITT) principle. In this approach, all participants will be included as per their initial assignment to the study, regardless of treatment adherence or other discontinuities. Multiple imputation was used to estimate missing data, creating up to five complete data sets.

To examine the effect of time (pre x post), group (intervention x control) and the interaction between them (time x group) on the outcome measures, generalized linear mixed models (GLMM) were used. The data were adjusted for interference variables, namely age, sex, education and socioeconomic status.

Model fit was assessed using the Akaike information criterion (AIC), considering four types of covariance matrices. The model with the best fit, according to the AIC, was selected based on the diagonal covariance matrix. Analyses were conducted with 95% confidence intervals and a 5% significance level. For multiple comparisons, the Bonferroni post-hoc test was used, and Cohen's effect size was calculated to provide a clinical interpretation of the results: small ($d = 0.2$), medium ($d = 0.5$), large ($d = 0.8$), and very large ($d > 1.0$).

3. Results

This study involved a sample of 40 elderly women, aged between 59 and 69 years. The application group included 21 participants, while the control group was composed of 19 individuals. The sociodemographic variables of both groups presented a balanced distribution.

Regarding the mean age, Student's t-test indicated no significant difference between the application group (63.95 ± 3.15) and the control group (64.32 ± 2.64), as represented by the statistical equation, $T(38) = -0.392$; $p = 0.697$. Student's t-test also showed that the mean years of schooling of the application group (11.65 ± 2.96) and the control group (12.16 ± 2.69) is not significant, as demonstrated by the statistical equation $T(37) = -0.559$; $p = 0.579$.

Student's t-test revealed that the mean economic classification for the application group (29.43 ± 9.75) does not differ significantly from the mean economic classification points of the control group (34.11 ± 11.48), represented by the statistical equation $T(38) = -1.392$; $p = 0.172$. Despite the difference in

the mean points, both groups (application and control) are classified in category A, being A2 and A1 respectively.

Digital competencies were assessed using a semi-structured questionnaire based on the MCDMSenior, administered before and after the intervention in the application and control groups. Detailed results are presented in Table 1.

Table 1

Significant differences were observed between the intervention and control groups after the application use period. Specifically, skill 2 showed a significant effect of time ($F = 7.329$, $p = 0.010$) and time*group interaction ($F = 4.897$, $p = 0.033$), while skill 3 exhibited a significant effect of time ($F = 5.002$, $p = 0.031$).

Regarding effect sizes, the intervention group demonstrated a moderate effect on competence 2 (Cohen's $d = 0.634$), and low effects on competences 1 and 5 (Cohen's $d = 0.219$ and Cohen's $d = 0.239$), respectively. On the other hand, the control group showed a moderate effect on competence 1 (Cohen's $d = 0.521$), and low effects on competences 4 and 5 (Cohen's $d = 0.429$ and Cohen's $d = 0.316$), in that order.

The Suitability Assessment of Materials (SAM) instrument and its Content Validation Index (CVI) were used to measure participants' satisfaction with the application. The average obtained in the evaluation was 35%, and the (CVI) presented an average value of 0.66. Consequently, the application elements were categorized as "inadequate or unacceptable", according to the established criteria.

Usability was measured separately using the System Usability Scale (SUS), together with the Consistency Value Index (CVI), which seeks to evaluate the user experience with digital health technologies. The average measured by the instrument was 71.5 points, and the CVI showed 0.70 as the average value obtained. Therefore, the usability and CVI of the application were described as "average", according to the criteria established by the instrument.

4. Discussion

The study reveals an initial uniformity in the sociodemographic characteristics of the groups analyzed, demonstrating the robustness of the research. The observed consistency reflects effective randomization of participants, which is crucial for validating the results, minimizing potential biases and strengthening the credibility of the findings. Consistency in these attributes is essential to ensure that any observed effects are attributable to the interventions and not to external factors.^{26,27}

The findings show that participants were predominantly from economic class A, and had, on average, 12 years of schooling. It is observed that elderly people with higher incomes have a greater understanding of digital skills,²⁸ and greater propensity to adopt technologies and perceive them as useful.²⁹ Furthermore, elderly people with higher levels of education are more likely to use smartphones and health apps, corroborating the results of this research.^{30,31}

Therefore, the results of this study offer a comprehensive analysis of the digital skills assessed in the sample of elderly people, revealing specific areas for continuous

improvement.

In competence 2, which assesses Internet navigation skills, the moderate effect size of Cohen's d in the intervention group (0.634) suggests that the application contributed to the development of this skill. Studies show a positive association between Internet use and cognitive performance among older adults,³² highlighting the need for personalized technology training for older adults with varied cognitive abilities and experiences.³³

In competence 1, focused on the use of basic technologies, a moderate effect of Cohen's d was observed in both the intervention group (0.219) and the control group (0.521). This indicates that participants in both groups improved fundamental skills, such as turning on and off the cell phone and installing mobile applications. These skills not only facilitate social interaction and access to health and well-being services, but also significantly promote autonomy and digital inclusion.^{2,34}

In competence 5, which assesses digital communication, showed a small Cohen's d effect in both groups (0.239, 0.316), recommending a low impact on this specific aspect of participants' digital skills. This underscores the complexity of digital communication among older adults and highlights the continued need for tailored interventions to overcome the specific barriers faced by this age group.³⁴

Regarding competence 4, which measures the ability to conduct online research, a small Cohen effect was observed in the control group (0.429), while in the intervention group there was no significant difference (0.087). However, a more detailed analysis of the raw data revealed a reception about the participants' practices regarding Internet research. Some research suggests that older adults who seek health information online may risk stress, excessive anxiety, and emotional distress.³⁵

Thus, this skill increases independence in seeking health information, reduces misinformation, and improves the ability to make one's own decisions.³⁶ Digital interventions aimed at educating individuals on selecting reliable online health information have shown significant improvements in participants ability to assess the credibility of information, emphasizing the value of this training in combating misinformation during events such as the COVID-19 pandemic.³⁷

Regarding the satisfaction findings, carried out by the SAM instrument, they indicated that, despite offering meetings to familiarize themselves with the use of the application, the educational materials provided in the application were considered "inadequate or unacceptable" for the participants. This suggests that the content may be too complex, and not well adapted to the needs of the users, or not presented in a clear and accessible way.²²

However, the difficulty in satisfying the elderly regarding the use of mobile applications is not limited to the complexity of the content. Recent studies indicate that lack of familiarity with technology, fear, and insecurity when handling electronic devices, as well as visual, motor and memory difficulties, are significant barriers for this population.^{38,39}

Phrases from participants who used the app, highlighting that, although the app was easy to use, they still faced fears and difficulties, showing the presence of barriers related to ageism: *“While the support is great, and I appreciate that they thought of me, I do worry about appearing incapable in front of younger people.”... “I understand how to use the app, but I still feel like I’m doing something wrong. The younger people seem to do everything so quickly, while I’m still learning.”*

Other phrases emphasize the difficulty in asking for help, especially for family members or younger people: *“Although the app is highly recommended, I prefer to use it when I go for walks with new friends so as not to bother my family. My grandchildren are good with technology, but I feel like I’m taking time away from other more important activities, and they always complain and look sullen.” ... “The app is great for its practicality, but I’m afraid of seeming like a burden. I often feel insecure and prefer to ask for help only when I’m with the girls, who also don’t know how, and we end up laughing about it.”*

The SUS questionnaire assessed the usability of a system, while the IVC measured the quality of the content. Both revealed “average” results.³⁸ A complementary study highlights that effective usability involves the integration of design and functionality, ensuring that users can not only operate the application, but also absorb and apply the information provided.³⁹

Therefore, it is crucial that developers and educators work together to create content that is both informative and easily digestible for older adults. Integrating user feedback into the design and iterative testing phase can be an effective strategy to achieve this goal. This approach is essential to improving the user experience, ensuring that digital products not only meet functional needs but also promote intuitive and enriching interaction.⁴⁰

Despite the significant results, this project has some limitations that must be considered. First, the sample size was small. The complexity of the guidance and technological and technical support during the implementation of the intervention justifies the recommendation of reduced samples for this type of study. Larger samples could make the quality of the support offered unfeasible. Even so, this reduced sample may have limited the generalization of some study outcomes.

Another limitation highlighted is the short intervention period used in the study. Short-term interventions may not fully capture the long-term effects of mobile app use on

older adults' digital skills. It is therefore suggested that future studies include longer follow-up periods to better assess the sustainability and lasting impact of digital interventions.

Finally, an important recommendation is to apply the results in other scenarios and contexts beyond the one studied. Replicating the study in different settings, such as urban and rural communities, different socioeconomic and cultural levels, can provide additional insights into the effectiveness of the mobile application in different elderly populations.

5. Conclusion

This study analyzed the impact of a mobile application on promoting digital skills among older adults. The results show that the application significantly contributes to improving these skills, including basic technology use, internet navigation, and online research. Furthermore, it is essential to understand the difficulties encountered by this group when using mobile applications and to promote continuous improvements through qualitative studies. Usability and user satisfaction are essential to ensure the acceptance and effectiveness of mobile applications, especially in supporting the health needs of older adults. Therefore, the development of technologies adapted to this target audience should be a priority, aiming at digital inclusion and the promotion of health and well-being.

Acknowledgements

The authors would like to thank the National Council for Scientific and Technological Development (CNPq), and the São Paulo Research Foundation (FAPESP). We extend our gratitude to the elderly individuals who agreed to participate and make this study possible.

Declaration of competing interest

The authors declare that they have no conflict of interest.

Authors' contributions

Sobrinho ACS and Júnior CRB managed the project. Sampaio LTDV and Sobrinho ACS wrote and revised the manuscript. Gomes GAO critically reviewed the manuscript. All authors contributed, reviewed and approved the final manuscript.

Funding

This project was supported by the National Council for Scientific and Technological Development (CNPq); and by the São Paulo Research Foundation (FAPESP) - No. 2023/16552-4.

References

1. LaBerge L. How COVID-19 Has Pushed Companies Over the Technology Tipping Point—and Transformed Business Forever. McKinsey & Company; 2020. <https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/how-covid-19-has-pushed-companies-over-the-technology-tipping-point-and-transformed-business-forever>.
2. Morris J, Allen C. Teaching Older People New Tricks: Tackling Digital Exclusion in Post-COVID Service Provision. *FPOP Bull Psychol Older People*. 2023;1(163):52–56. doi:10.53841/bpsfpop.2023.1.163.52
3. Velho FD, Herédia VBM. Quarantined Senior Citizens and the Impact of Technology on Their Life. *Revista Rosa dos Ventos - Turismo e Hospitalidade*. 2020;12(Special):1–14. doi:10.18226/21789061.v12i3a10
4. Feng F, Xu H, Sun Y, et al. Exercise for Prevention of Falls and Fall-Related Injuries in Neurodegenerative Diseases and Aging-Related Risk Conditions: A Meta-analysis. *Front Endocrinol*. 2023;14:1187325. doi:10.3389/fendo.2023.1187325
5. Silva TC da, Scarmagnan GS, Batiston AP, Santos ML de M, Christofolletti G. Impacto da Pandemia da COVID-19 nas Funções Cognitivas e Motoras de Pessoas Idosas: Um Estudo Coorte de 3 Anos. *Rev Bras Geriatr Gerontol*. 2022;25:e220146. doi:10.1590/1981-22562022025.220146.pt
6. Jaumotte F, Oikonomou M, Pizzinelli C, Tavares MM. How Pandemic Accelerated Digital Transformation in Advanced Economies. *IMF Blog*. 2023. <https://www.imf.org/en/Blogs/Articles/2023/03/21/how-pandemic-accelerated-digital-transformation-in-advanced-economies>.
7. Lee P, Aikens J, Richardson C, et al. Uso de Aplicativo de Saúde Móvel Entre Adultos Mais Velhos. *Pesquisa Nacional da Universidade de Michigan sobre Envelhecimento Saudável*; 2022. <https://dx.doi.org/10.7302/4019>. Accessed [Date].
8. Van ES, Cai ZR, Nava V, Joy I, Rapaport BR, Ko J, et al. Development of a Digital Tool for Home-Based Monitoring of Skin Disease for Older Adults. *Skin Health Dis*. 2023;3(5). doi:10.1002/ski2.235
9. Canali S, Schiaffonati V, Aliverti A. Challenges and Recommendations for Wearable Devices in Digital Health: Data Quality, Interoperability, Health Equity, Fairness. *PLOS Digit Health*. 2022;1(10):e0000104. doi:10.1371/journal.pdig.0000104
10. Tuena C, Pedroli E, Trimarchi PD, et al. Usability Issues of Clinical and Research Applications of Virtual Reality in Older People: A Systematic Review. *Front Hum Neurosci*. 2020;14:93. doi:10.3389/fnhum.2020.00093
11. Zainal A, Aziz NFA, Ahmad NA, et al. Usability Measures Used to Enhance User Experience in Using Digital Health Technology Among Elderly. *Bull Electr Eng Inform*. 2023;12(3):1825–1832. doi:10.11591/eei.v12i3.4773
12. Chee SY. Age-Related Digital Disparities, Functional Limitations, and Social Isolation: Unraveling the Grey Digital Divide Between Baby Boomers and the Silent Generation in Senior Living Facilities. *Aging Ment Health*. 2023;28(4):1–12.

13. Frishammar J, Essén A, Bergström F, Ekman T. Digital Health Platforms for the Elderly? Key Adoption and Usage Barriers and Ways to Address Them. *Technol Forecast Soc Change*. 2023;189:122319.
14. Machado LS. Modelo de Competências Digitais para M-Learning com Foco nos Idosos (MCDMSÊNIOR). Ibict.br; 2019. https://www.oasisbr.ibict.br/vufind/Record/URGS_050e5d bc2c23c076004b432f644fe92a?lng=pt-br.
15. Fenge LA, Melacca D, Lee S, Rosenorn-Lanng E. Older Peoples' Preferences and Challenges When Using Digital Technology: A Systematic Review With Particular Reference to Digital Games. *Bournemouth Univ Res Online*. 2019. <https://eprints.bournemouth.ac.uk/32574/>.
16. Le TV, Galperin H, Traube D. The Impact of Digital Competence on Telehealth Utilization. *Health Policy Technol*. 2023;12(1):100724. doi:10.1016/j.hlpt.2023.100724
17. Sobrinho ACS, Gomes GA de O, Júnior CRB. Developing a Multiprofessional Mobile App to Enhance Health Habits in Older Adults: User-Centered Approach. *JMIR Form Res*. 2024;8(1):e54214. <https://formative.jmir.org/2024/1/e54214>.
18. Moher D, Hopewell S, Schulz KF, et al. CONSORT 2010 Explanation and Elaboration: Updated Guidelines for Reporting Parallel Group Randomised Trials. *Int J Surg*. 2012;10(1):28–55. doi:10.1016/j.ijsu.2011.10.001
19. Freitas S, Simões MR, Martins C, Vilar M, Santana I. Estudos de Adaptação do Montreal Cognitive Assessment (MoCA) para a População Portuguesa. *Aval Psicol*. 2014;9(3):345–357. https://pepsic.bvsalud.org/scielo.php?script=sci_arttext&pid=S1677-04712010000300002.
20. Lacroix A, Kressig RW, Muehlbauer T, et al. Effects of a Supervised Versus an Unsupervised Combined Balance and Strength Training Program on Balance and Muscle Power in Healthy Older Adults: A Randomized Controlled Trial. *Gerontology*. 2015;62(3):275–288.
21. Associação Brasileira de Empresas de Pesquisa. Critério Brasil - ABEP. <https://www.abep.org/criterio-brasil>.
22. Sousa CS, Turrini RNT, Poveda VB. Tradução e Adaptação do Instrumento “Suitability Assessment of Materials” (SAM) para o Português. *Rev Enferm*. 2015;9(5):7854–7861. doi:10.5205/1981-8963-v9i5a10534p7854-7861-2015
23. Alvarez L, Ribeiro P, Damiance M. O Suitability Assessment of Materials (SAM) e a Avaliação de Materiais Educativos em Saúde. 2024. https://fema.edu.br/wp-content/uploads/2023/08/O_SUITABILITY_ASSESSMENTE_OF_MATERIALS_SAM_E_A_AVALIAC%CC%A7A%CC%83O_DE_MATERIAIS_EDUCATIVOS_EM_SAU%CC%81DE.pdf.
24. Takano E, Maruyama H, Takahashi T, et al. User Experience of Older People While Using Digital Health Technologies: A Systematic Review. *Appl Sci*. 2023;13(23):12815. doi:10.3390/app132312815
25. Lourenço DF, Carmona EV, Lopes MHBM. Tradução e Adaptação Transcultural da

- System Usability Scale para o Português do Brasil. *Aquichan*. 2022;22(2). doi:10.5294/aqui.2022.22.2
26. Kirchner GJ, Kim AH, Smith NP, et al. Few Randomized Controlled Trials in Spine Surgery in the United States Include Sociodemographic Patient Data: A Systematic Review. *J Am Acad Orthop Surg*. 2023;31(8):421–427. doi:10.5435/JAAOS-D-22-00838
27. Lipardo D, Manlapaz D, Orpilla V, et al. Profiling Demographic Characteristics and Balance Performance Measures of Community-Dwelling Older Adults Participating in a Randomized Arnis-Based Exercise Program. *Philipp J Phys Ther*. 2023;43–44. doi:10.46409/002.yemk8186
28. Raymundo TM. Aceitação de Tecnologias por Idosos [dissertação]. São Carlos, Brazil: Universidade de São Paulo; 2013. https://www.teses.usp.br/teses/disponiveis/82/82131/tde-27062013-145322/publico/TD_E_TaiuaniMarquineRaymundo.pdf. Accessed [Date].
29. Lee M, Kang D, Yoon J, et al. The Difference in Knowledge and Attitudes of Using Mobile Health Applications Between Actual User and Non-User Among Adults Aged 50 and Older. *PLoS One*. 2020;15(10):e0241350. doi:10.1371/journal.pone.0241350
30. Gałczyk M, Zalewska A, Sobolewski M, Fernandes H. Assessment of Physical Activity Levels and Back Pain Among Poles and Portuguese in the Further Year of the COVID-19 Pandemic: A Pilot Study. *BMC Public Health*. 2024;24(1).
31. Nikou S. Mobile Technology and Forgotten Consumers: The Young-Elderly. *Int J Consum Stud*. 2015;39(4):294–304. doi:10.1111/ijcs.12187
32. Zhang H, Zhou M. Internet Use and Cognitive Ability Among Older Adults in China: Results From a National Household Survey. *Res Sq*. 2024. doi:10.21203/rs.3.rs-4311720/v1
33. Sarker A, Kahana J, Kahana E. Internet Literacy From Grandchildren or the Younger Generation: A New Direction for Gerontechnology. *Innov Aging*. 2022;6(Suppl 1):584–585.
34. Adnan M, Çağlar Özbek. Digital Competences of Older Women in Turkey: Gender and Ageing as Double Danger. *Educ Gerontol*. 2023;49(12):1082–1099. doi:10.1080/03601277.2023.2209452
35. Jokić-Begić N, Bagarić B. Pretraživanje Zdravstvenih Informacija na Internetu—Implikacije za Zdravstvenu Anksioznost Kod Starijih Osoba. *Psihologijske Teme*. 2020;29(2):401–425. doi:10.31820/pt.29.2.10
36. Suherman S. Online Research Skills (ORS): Solusi Literasi Mahasiswa Perguruan Tinggi di Masa Pandemi Covid-19. *IQRA: J Ilmu Perpustakaan dan Informasi*. 2022;16(1):70. doi:10.30829/iqra.v16i1.10153
37. Hassan RIA, Sabry HA. Leveraging the Ability of Online Health Information Seekers to Find Credible Online Sources. *Res Sq*. 2023;doi:10.21203/rs.3.rs-1336448/v2
38. Huang Z, Benyoucef M. A Systematic Literature Review of Mobile Application Usability: Addressing the Design Perspective. *Universal Access Inf Soc*. 2022;22.

doi:10.1007/s10209-022-00903-w

39. Moumane K, Idri A, Abran A. Usability Evaluation of Mobile Applications Using ISO 9241 and ISO 25062 Standards. SpringerPlus. 2016;5:2171. doi:10.1186/s40064-016-2171-z
40. Uehara BCA. Melhorando a Experiência do Usuário com Testes de Usabilidade: Compreensão, Aplicação e Análise [dissertação]. São Paulo, Brazil: Universidade de São Paulo; 2022. <https://www.teses.usp.br/teses/disponiveis/27/27163/tde-08112022-161016/publico/BarbaraCristinaAraujoUeharaCorrigida.pdf>.

Supplementary Files

Table.

URL: <http://asset.jmir.pub/assets/939c48d864dc2660a6c3dc55ed928838.docx>

Title page.

URL: <http://asset.jmir.pub/assets/4265354e94d1e2e6ddd9fe1af1dfba5f.docx>

Untitled.

URL: <http://asset.jmir.pub/assets/3988efdc37e8c589c3e5a58fb9f3277e.pdf>

CONSORT (or other) checklists

Untitled.

URL: <http://asset.jmir.pub/assets/656a4a48066a47b763adc66d6779c704.pdf>