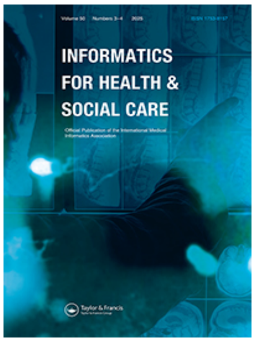

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RESEARCH

Identifying and prioritizing the barriers and facilitators to mHealth adoption among older adults: an expert-driven best–worst method approach to inform healthcare

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ABSTRACT

This study identifies and prioritizes barriers and facilitators shaping older adults' adoption of mobile health (mHealth) technologies, including apps and wearables. Using the Best–Worst Method (BWM), an expert-driven multi-criteria decision-making approach, we evaluate a structured framework spanning five domains: Technological Proficiency and Confidence, Physical and Cognitive Limitations, Perceived Relevance and Need, Usability and Design, and Economic Factors. A multidisciplinary panel of clinicians, gerontology and rehabilitation specialists, public-health researchers, and HCI/technology practitioners assessed the relative importance of each domain and its sub-criteria. Results indicate that personal barriers dominate: Physical and Cognitive Limitations and Technological Proficiency/Confidence rank highest, with lack of familiarity with technology and limited technical skills emerging as pivotal obstacles. By contrast, Economic Factors and Usability/Design, while relevant, are comparatively less decisive in determining uptake. The findings translate into practical guidance for health systems and developers, emphasizing staged digital-literacy supports, age-inclusive interface requirements (clear text, high contrast, large touch targets, forgiving flows), and lightweight clinician cueing integrated into routine care. The proposed framework offers a replicable, decision-oriented basis to prioritize interventions, inform procurement and design, and monitor implementation, with the overarching aim of improving mHealth use, self-management, and quality of life among older adults.

KEYWORDS
Mobile health; multi-criteria decision making; barriers and facilitators; older adults; technology adoption

Introduction

Today, advances in technology help older adults achieve better health care and higher standards of living.[1] Mobile health (mHealth) is defined by the World Health Organization as the "medical and public health practice supported by mobile technologies."[2] The widespread use of mobile devices and their increasing capabilities have made them ideal for delivering health interventions.[3] mHealth technologies have emerged as an accessible and convenient approach to addressing various areas of health and well-being for the older adult population.[4] mHealth offers many health services: reporting of health information, monitoring of patients, educational support for individuals and their caregivers, etc.[5] Moreover, as the population ages, the effective use of mHealth by older adults presents an opportunity to improve chronic disease management and deliver care more efficiently, easing the burden on healthcare systems.

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Given the potential profits that mHealth services and applications can bring to older adults, it is essential to understand their perceptions and adoption of these services and to assist them in this process.[6] mHealth app usage is low for many of these systems due to low adoption rates, inconsistent usage, and a lack of user engagement. Usability is directly related to adoption and sustained participation.[4] Although technology use is increasing among older adults, they continue to lag behind younger populations in technology adoption. So, it is essential to examine older adults' perceptions of mHealth to identify possible barriers and facilitators to its adoption.[3]

Kruse et al.[7] conducted a detailed literature review and noted three barriers to mHealth adoption: complexity, limited usage, and ineffective practice. Pan et al.[8]divided their study into two main chapters. The first part of the study consists of a literature review and surveys to reveal the perceptions of older adults regarding mHealth services. The second part includes interviews to find and define the barriers to older adults' mHealth applications. Aranha et al.[9] identified three main categories of barriers and facilitators to mHealth adoption among older adults based on their literature review: general attitude toward technology, social influence, and usability features of the mHealth system. Cajita et al.[3] and Schroeder et al.[10] divided the barriers into three categories: person-related, technology-related, and contextual. Pan and Dong[6] focused on understanding the barriers to older adults' mHealth adoption, proposing an approach called the pine tree model. Das and Sengar used the fuzzy Analytic Hierarchy Process (AHP) to analyze the eHealth adoption barriers.[11] However, previous research has predominantly identified these barriers qualitatively without quantifying their relative importance. For healthcare decision-makers, understanding which factors are most critical is essential for prioritizing resources and strategies to improve mHealth adoption among older adults.

The motivation behind this study stems from the growing need to enhance the adoption of mHealth technologies among older adults, who stand to benefit significantly from these advancements in healthcare. Despite the potential benefits, many older individuals face barriers that hinder their use of mHealth tools, leading to suboptimal health outcomes and reduced quality of life. This study aims to systematically identify and analyze the key barriers and facilitators impacting mHealth adoption using MCDM methods, specifically the BWM. MCDM approaches provide a robust and systematic basis for assessing varied factors. Moreover, it allows the simultaneous evaluation of many conflicting criteria, effectively reflecting the opinions of many experts with different expertise and knowledge bases in the results. After identifying the critical factors through expert opinion and a detailed literature review, the technique is implemented step by step. By evaluating these factors through expert assessments and employing BWM, the study seeks to provide actionable insights into the relative importance of various barriers and facilitators. This structured approach aims to inform the design and implementation of more accessible and user-friendly mHealth solutions within healthcare services. Ultimately, the study seeks to enhance the uptake of mHealth technologies, thereby improving health management and overall well-being for older adults.

This study makes several significant contributions to the field of mHealth adoption among older adults. It introduces a comprehensive framework by categorizing barriers and facilitators into five main criteria: Technological Proficiency and Confidence, Physical and Cognitive Limitations, Perceived Relevance and Need, Usability and Design Factors, and Economic Factors. This provides a nuanced understanding of the factors influencing technology adoption. The use of the BWM to determine the relative importance of these factors through expert evaluations is a novel approach, ensuring that the weights reflect expert consensus and enhancing the reliability of the findings. Additionally, the study's focus on sub-criteria offers a granular analysis of specific challenges and facilitators, enabling targeted strategies for overcoming adoption barriers. These insights have practical implications for designing and implementing user-centered mHealth technologies, informing interventions and policies that aim to improve adoption rates among older adults.

Overall, the study offers a structured framework, expert-driven insights, and actionable recommendations, significantly contributing to the understanding and advancement of mHealth adoption. It bridges research and practical decision-making to improve mHealth uptake among aging populations.

Literature review

In this section, an organized literature review is applied to suggest the theoretical background for mHealth research. The main goal is to create a concise and relevant examination framework for future works. For this aim, the SCOPUS database was used to retrieve relevant publications, and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) tactic was followed to settle a planned review process. PRISMA approach, which has been developed and shared in recent years for conducting inclusive literature reviews, was recognized by Moher et al..[12] In this style, the first stage covers determining the criteria, the second stage is to evaluate sources, and the third stage involves selecting appropriate shares of literature. The final stage includes data gathering and selection of data fundamentals, correspondingly.[13,14]

In this paper, the following search keywords were used in SCOPUS: *"mHealth" AND "barriers" OR "facilitators" OR "assessment" OR "evaluation" AND "multi-criteria" OR "mcdm" OR "mcda" OR "madm" OR "Multi-Objective Decision Making" OR "Multi-Criteria Decision Analysis" OR ahp OR topsis OR vikor OR codas OR waspas OR edas OR bwm OR aras OR saw OR swara OR fucom OR anp OR electre OR promethee OR moora OR multimoora OR copras OR dematel OR critic OR cocoso OR mabac OR "entropy method" OR "Analytic Hierarchy Process" OR "Technique for Order of Preference by Similarity to Ideal Solution" OR "Vise Kriterijumska Optimizacija I Kompromisno Resenje" OR "entropy method" OR "Combinative Distance-Based Assessment" OR "Weighted Aggregated Sum Product Assessment" OR "Evaluation Based on Distance from Average Solution" OR "Best-Worst Method" OR "Additive Ratio Assessment" OR "Simple Additive Weighting" OR "Step-wise Weight Assessment Ratio Analysis" OR "Full Consistency Method" OR "Analytic Network Process" OR "Elimination et Choice Translating Reality" OR "Preference Ranking Organization Method for Enrichment Evaluations" OR "Multi-Objective Optimization on the Basis of Ratio Analysis" OR "Complex Proportional Assessment" OR "Decision-Making Trial and Evaluation Laboratory" OR "Criteria Importance Through Intercriteria Correlations."* As a result of this search, 50 publications were found. Table 1 summarizes the most relevant documents on this research area.

Table 1 shows that existing literature, particularly in studies focusing on barriers and motivations for mHealth practices among older adults, generally employs traditional analysis methods. This study addresses this critical topic more systematically by detailing the barriers and facilitators through a literature review and expert opinions, and it offers a robust solution to the problem, particularly using the BWM method. This MCDM technique provides a strong framework for evaluation and choice problems. This technique, which uses expert assessments to determine the relative importance of various critical factors, is a new approach. It ensures that the weights reflect expert consensus and

Table 1. Overview of the related works.

References	Focus area	Techniques
[15]	Identifying the barriers and facilitators to older people's use of mHealth	Direct content analysis
[16]	Identifying the barriers and facilitators to older people's health interventions	Review
[3]	Identifying the barriers and facilitators to older people's use of mHealth	Technology Acceptance Model
[9]	Identifying the barriers and facilitators to older people's health interventions	Review
[6]	mHealth Adoption Among Older Adults	Pine tree model
[1]	Identifying the barriers and facilitators to older people's use of mHealth	Bibliometric Analysis
[4]	Accessible mHealth Apps for Older Adults	Universal Design
[17]	Evaluating mHealth App Quality	Fuzzy BWM, Weighted Heronian Mean, Fuzzy TOPSIS
[18]	M-health valuation for college students	Muirhead Means, Fuzzy MULTIMOORA
This study	*Identifying the barriers and facilitators to older adults' use of mHealth*	*BWM*

enhances the consistency of the results. Thereby, these visions have applied implications for designing and applying user-centered mHealth technologies, informing interventions and strategies that are intended to advance adoption rates among older adults.

Best worst method

This study employs a structured MCDM approach to identify and prioritize the barriers and facilitators to mHealth adoption among older adults. Using the BWM, a comprehensive framework of criteria and sub-criteria was developed and evaluated based on expert opinions from diverse fields. The analysis aimed to calculate the relative importance of each factor, ensuring reliable and actionable insights.

BWM, one of the MCDM methods, is a subjective weighting approach developed by Rezai.[19,20] This method was formulated by addressing the shortcomings of the Analytical Hierarchy Process (AHP) method. AHP requires a large number of pairwise comparisons, which often leads to inconsistencies. BWM adopts a basic principle based on the use of reference objects for comparison purposes.[21] Furthermore, compared to previous approaches, this method yields more accurate weights.[21] By focusing only on comparisons involving the best and worst criteria, BWM reduces the workload on experts and improves consistency in the judgments, which is advantageous for practical decision-making contexts. These objects are considered as most important and least important, and they are defined as best (C_b) and worst (C_w). In BWM, only comparisons with these reference objects are sufficient. The steps of the BWM are as follows:

Step 1. Experts define the set of n evaluation criteria $\{C_1, C_2, \ldots, C_N\}$ for the problem.

Step 2. Experts evaluate the criteria they consider the best (C_b) and the worst (C_w).

Step 3. Each expert evaluates the relative preference levels between the best criterion and each different criterion in the set, generally using a Likert scale. Let a_{bJ} represents the preference level of the best over the criterion C_j where $j \neq b$.The evaluation offers $A_b = \left(a_{b1}, \ldots, a_{bj}, \ldots, a_{bn}\right)$ vector stated as best-to-others and $a_{bb} = 1$.

Step 4. Each expert designates the preference levels of the other criteria (except the best) over the worst. The evaluation offers the others-to-worst vector, $A_b = \left(a_{1w}, \ldots, a_{jw}, \ldots, a_{nw}\right)^T$ where a_{jw} represents the preference level of the criterion C_j over the worst where $j \neq b or j \neq w$.

Step 5. Decision criteria weights should be determined proportionally to the preference scores of the best over the other criteria ($w_b / w_j^1 = a_{bj}$). As well as the preference scores of the other criteria over the worst ($w_j^1 / w_w = a_{jw}$). This suggests determining the set of weights ($w_1^1, w_2^1, \ldots, w_n^1$) that minimizes the differences between $\left|\frac{w_b}{w_j^1} - a_{bj}\right|$ and $\left|\frac{w_j^1}{w_w} - a_{jw}\right|$. The minimization model is given in Equation 1.

$$\min \xi \tag{1}$$

subject to:

$$\left|\frac{w_b}{w_j^1} - a_{bj}\right| \leq \xi, \forall_j$$

$$\left|\frac{w_j^1}{w_w} - a_{jw}\right| \leq \xi, \forall_j$$

$$\sum_j w_j^T = 1$$

$$w_j \geq 0, \quad \forall_j$$

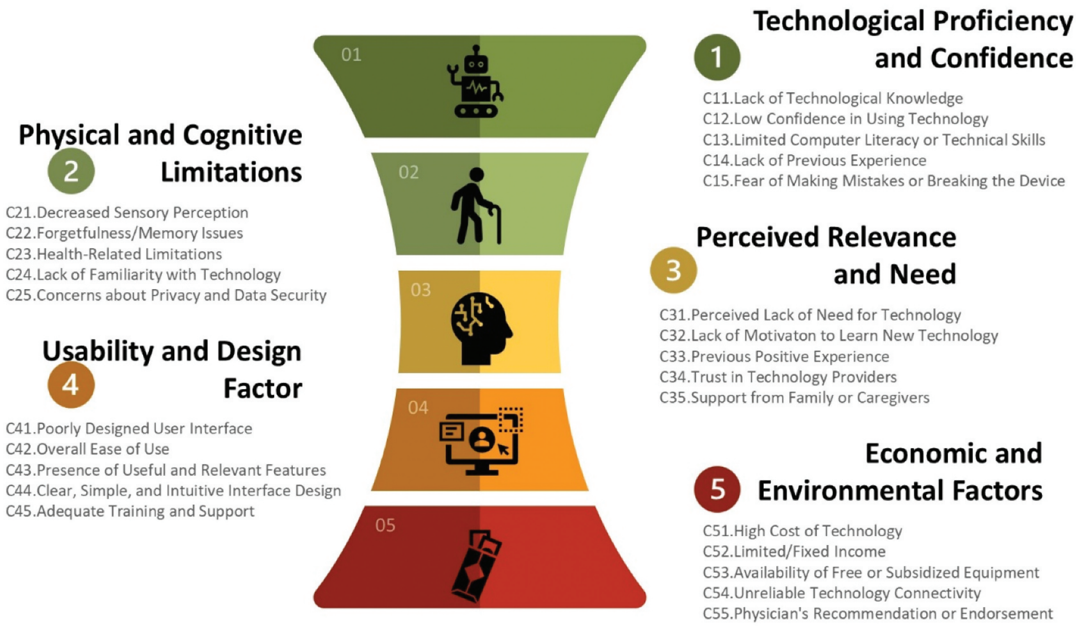

Figure 1. The barriers and facilitators.

Barriers and facilitators

In the first step, we defined 25 barriers and facilitators grouped under five main headings with expert opinions and literature review[3,15,21] (see Figure 1).

The barriers and facilitators for mHealth adoption among older adults can be summarized into five key criteria. Technological Proficiency and Confidence encompass issues such as a lack of technological knowledge, low confidence, limited computer literacy, a lack of experience with mobile technology, and fear of making mistakes. These factors can hinder users from effectively engaging with mHealth tools. Physical and Cognitive Limitations involve challenges such as decreased sensory perception, forgetfulness, health-related issues, and privacy concerns. These limitations can impact users' ability to use and trust mHealth technologies effectively. Perceived Relevance and Need cover how users view the necessity of mHealth technologies. A lack of perceived need, motivation, or trust in technology providers can affect adoption, while previous positive experiences and support from family can facilitate it. Usability and Design Factors address the user-friendliness of mHealth tools. Poor design, ease of use, intuitive interfaces, and the presence of useful features are crucial for adoption, as is adequate training and support. Economic Factors include the cost of technology, limited incomes, and the availability of free or subsidized equipment. These factors, along with unreliable connectivity and physician recommendations, can influence the accessibility and acceptance of mHealth tools.

This comprehensive framework ensures that all major dimensions of the adoption challenge are considered, allowing healthcare managers to pinpoint specific domains for intervention and improvement.

Results

In this study, the expert team's role is crucial for several reasons: i) identifying the barriers and facilitators to mHealth adoption, ii) determining the relative importance of these factors within a hierarchical structure, and iii) analyzing and validating the results to ensure accuracy and reliability in the context of mHealth adoption.

The expert group formed to determine the weights of the barriers and facilitators for mHealth adoption among older adults consists of 11 professionals with diverse expertise. This group includes academicians, gerontologists, healthcare professionals, technology adoption specialists, and psychologists, ensuring a well-rounded perspective on the factors influencing mHealth use. The group also includes experts in human-computer interaction and usability design, who contribute insights on how design and technology-related factors affect older users. Additionally, public health professionals and social workers provide valuable input on the social, economic, and contextual barriers that may impact adoption. This multidisciplinary team enables a comprehensive evaluation of the identified factors, ensuring that the importance levels assigned reflect a holistic understanding of the challenges and opportunities in mHealth adoption for older adults. Notably, including practitioners (such as healthcare providers and social workers) in the expert panel grounds the findings in practical experience, enhancing their relevance for real-world application. Details of the expert panel are presented in Table 2.

In this section, the BWM is employed to evaluate the priorities of the barriers and facilitators (criteria). The outlined BWM steps are followed to determine the weights of these criteria. Initially, the weights of the main criteria are calculated by identifying the most important (best) and least important (worst) criterion, as determined by the experts and presented in Table 3.

Table 2. Information about experts.

ID	Experience	Education	Job title	Research area/Expertise
E-1	18 years	MD, Geriatrics; MSc (Clinical Epidemiology)	Consultant Geriatrician	Multimorbidity management, mHealth for chronic care, clinician adoption, and workflow fit.
E-2	12 years	PhD (Human–Computer Interaction)	Associate Professor of HCI	Usability, accessibility, age-inclusive UI, and persuasive design for older adults
E-3	20 years	Bachelor	Clinical Nurse Specialist	Patient education, remote monitoring adherence, and digital literacy training
E-4	10 years	PhD (Biomedical/Health Informatics)	Assistant Professor	Decision support, telehealth integration, interoperability, data standards
E-5	14 years	PhD (Public Health); MPH	Public Health Scientist	Health equity, community-based mHealth, implementation science
E-6	11 years	PhD (Rehabilitation Sciences)	Rehabilitation Researcher	Motor/cognitive aging, sensor-based rehab, wearables usability
E-7	13 years	PhD (Clinical Psychology)	Health Psychologist	Behavior change, technology acceptance (UTAUT/TPB), privacy attitudes
E-8	16 years	Master of Science	Senior Medical Social Worker	Caregiver support, socio-economic barriers, and care coordination via mobile tools
E-9	9 years	MSc (Biomedical Engineering)	Telehealth Systems Engineer	Device usability, connectivity/reliability in buildings, interoperability testing
E-10	22 years	MD (Family Medicine)	Primary Care Physician	Preventive care, physician recommendation cues, and integration of apps in primary care
E-11	8 years	PhD (Health Economics/ Policy)	Health Policy Analyst	Cost–benefit of digital health, reimbursement models, and adoption incentives

Table 3. The most and the least important main criteria by experts.

	Best	Worst
E-1	C2.Physical and Cognitive Limitations	C5.Economic Factors
E-2	C1.Technological Proficiency and Confidence	C3.Perceived Relevance and Need
E-3	C4.Usability and Design Factors	C3.Perceived Relevance and Need
E-4	C2.Physical and Cognitive Limitations	C5.Economic Factors
E-5	C1.Technological Proficiency and Confidence	C5.Economic Factors
E-6	C1.Technological Proficiency and Confidence	C5.Economic Factors
E-7	C2.Physical and Cognitive Limitations	C5.Economic Factors
E-8	C1.Technological Proficiency and Confidence	C4.Usability and Design Factors
E-9	C2.Physical and Cognitive Limitations	C4.Usability and Design Factors
E-10	C2.Physical and Cognitive Limitations	C3.Perceived Relevance and Need
E-11	C4.Usability and Design Factors	C3.Perceived Relevance and Need

Table 4. Decision vectors for main criteria.

	Best-to-others	Others-to-worst	Consistency ratio	Associated threshold
E-1	8,1,4,6,9	3,9,4,5,1	0.29	0.31
E-2	1,2,8,4,6	8,7,1,6,4	0.29	0.30
E-3	5,6,8,1,3	5,3,1,8,6	0.30	0.30
E-4	3,1,5,3,7	5,7,3,5,1	0.19	0.28
E-5	1,4,3,3,5	5,4,3,3,1	0.22	0.23
E-6	1,2,4,6,9	9,8,5,4,1	0.21	0.30
E-7	3,1,2,5,6	3,6,5,2,1	0.13	0.27
E-8	1,4,3,2,5	5,2,3,1,4	0.20	0.23
E-9	2,1,4,6,3	5,6,3,1,4	0.20	0.26
E-10	5,1,9,7,4	6,9,1,4,7	0.29	0.30
E-11	5,4,7,1,2	2,3,1,7,6	0.12	0.28

Table 5. Main criteria weights.

	E-1	E-2	E-3	E-4	E-5	E-6	E-7	E-8	E-9	E-10	E-11
Technological Proficiency and Confidence	0.088	0.447	0.126	0.184	0.433	0.462	0.164	0.416	0.243	0.138	0.104
Physical and Cognitive Limitations	0.571	0.279	0.105	0.466	0.137	0.271	0.430	0.118	0.416	0.547	0.130
Perceived Relevance and Need	0.175	0.042	0.049	0.111	0.183	0.135	0.246	0.158	0.121	0.045	0.055
Usability and Design Factors	0.117	0.140	0.510	0.184	0.183	0.090	0.098	0.072	0.058	0.098	0.451
Economic Factors	0.049	0.093	0.210	0.054	0.063	0.042	0.061	0.237	0.162	0.172	0.260

The expert evaluations reveal a strong consensus on the significance of C2. Physical and Cognitive Limitations and Technological Proficiency and Confidence, with multiple experts identifying these as the most important criteria. C2. Physical and Cognitive Limitations are chosen as the top priority by five experts, while C1. Technological Proficiency and Confidence is highlighted by four experts. Conversely, C5. Economic Factors are frequently deemed the least important by five experts. From a practical perspective, this consensus suggests that mHealth adoption efforts should prioritize addressing physical and cognitive limitations, as well as improving technological proficiency among older adults. In contrast, economic issues may be considered a lower priority, given the broad availability of devices. After gathering expert opinions, both Best-to-Others and Others-to-Worst vectors are constructed as shown in Table 4.

Mathematical models are developed for each expert using the vectors provided in Table 4, allowing for the calculation of the main criteria weights, as presented in Table 5. Additionally, the consistency ratio for each expert is assessed, confirming that all evaluations are consistent.

As an example, a mathematical model for E-1 is given below.

Let the five main criteria be C_1–C_5:

C_1. Technological Proficiency & Confidence, C_2 Physical & Cognitive Limitations, C_3 Perceived Relevance & Need, C_4 Usability & Design, C_5 Economic Factors.

E-1 selects $B = C_2$ and $W = C_5$. Reported decision vectors are: Best-to-Others $A_B = [a_{B1}, a_{B2}, a_{B3}, a_{B4}, a_{B5}] = [8, 1, 4, 6, 9]$, Others-to-Worst $A_W = [a_{1W}, a_{2W}, a_{3W}, a_{4W}, a_{5W}] = [3, 9, 4, 5, 1]$.

Plugging these into the linear model gives (omitting identities with zero residual such as $w_2 - w_2$ and $w_5 - w_5$):

Best-to-Others (with $B = 2$):

- $-\xi \leq w_2 - 8w_1 \leq \xi$
- $-\xi \leq w_2 - 4w_3 \leq \xi$
- $-\xi \leq w_2 - 6w_4 \leq \xi$
- $-\xi \leq w_2 - 9w_5 \leq \xi$

Others-to-Worst (with $W = 5$):

- $-\xi \leq w_1 - 3w_5 \leq \xi$
- $-\xi \leq w_2 - 9w_5 \leq \xi$
- $-\xi \leq w_3 - 4w_5 \leq \xi$
- $-\xi \leq w_4 - 5w_5 \leq \xi$

Normalization and nonnegativity:

$$w_1 + w_2 + w_3 + w_4 + w_5 = 1, w_j \geq 0.$$

Solving this LP for E-1 yields the weight vector: $(w_1, w_2, w_3, w_4, w_5) = (0.088, 0.571, 0.175, 0.117, 0.049)$, The maximum absolute deviation at this solution is $\xi \approx 0.133$.

The sub-criteria weights are determined using the BWM method once more. The same experts construct the Best-to-Others and Others-to-Worst vectors for the sub-criteria under each of the four main criteria, as shown in *Table A1 (see Appendix)*. The experts' evaluations are then analyzed for consistency, and all are confirmed as consistent. Following this, the BWM steps are applied to determine the sub-criteria weights for each expert, as shown in *Table A2 (see Appendix)*.

The weights of the sub-criteria are computed by multiplying each sub-criterion's weight by the corresponding main criterion's weight for each expert. These weights are then aggregated, assuming equal influence from each expert. The final criteria weights and their rankings are detailed in Table 6.

The analysis of barriers and facilitators for mHealth adoption reveals distinct priorities among the identified factors. C11. Lack of Familiarity with Technology emerges as the most critical barrier, with the highest weight of 0.0880, reflecting its significant impact on adoption. This is followed by C13. Limited Computer Literacy or Technical Skills (0.0857) and C23. Health-Related Limitations (0.0732). Conversely, C15. Fear of Making Mistakes or Breaking the Device and C33. Previous Positive Experience with Mobile Technology ranks as the least influential, with weights of 0.0157 and 0.0119, respectively. C14. Lack of Previous Experience with Mobile Technology and C25. Concerns about Privacy and Data Security also rank low, highlighting that these factors are less critical compared to others. C21. Decreased Sensory

Table 6. Importance and rankings of barriers and facilitators.

Barriers and facilitators	Weight	Rank
C11.Lack of Technological Knowledge	0.0659	**5**
C12.Low Confidence in Using Technology	0.0439	10
C13.Limited Computer Literacy or Technical Skills	0.0857	**2**
C14.Lack of Previous Experience with Mobile Technology	0.0436	11
C15.Fear of Making Mistakes or Breaking the Device	0.0157	22
C21.Decreased Sensory Perception (e.g., vision, hearing)	0.0706	**4**
C22.Forgetfulness/Memory Issues	0.0631	6
C23.Health-Related Limitations	0.0732	**3**
C24.Lack of Familiarity with Technology	0.0880	**1**
C25.Concerns about Privacy and Data Security	0.0206	20
C31.Perceived Lack of Need for Technology	0.0263	16
C32.Lack of Motivation to Learn New Technology	0.0384	12
C33.Previous Positive Experience with Mobile Technology	0.0119	24
C34.Trust in Technology Providers	0.0125	23
C35.Support from Family or Caregivers	0.0309	13
C41.Poorly Designed User Interface	0.0183	21
C42.Overall Ease of Use	0.0507	8
C43.Presence of Useful and Relevant Features	0.0259	17
C44.Clear, Simple, and Intuitive Interface Design	0.0591	7
C45.Adequate Training and Support	0.0280	14
C51.High Cost of Technology	0.0212	19
C52.Limited/Fixed Income	0.0230	18
C53.Availability of Free or Subsidized Equipment	0.0266	15
C54.Unreliable Technology Connectivity	0.0103	25
C55.Physician's Recommendation or Endorsement	0.0466	9

Perception and C35. Support from Family or Caregivers is noted as a relatively important barrier, but it does not rank among the highest. Overall, the findings indicate that addressing familiarity with technology and technical skills is crucial for enhancing mHealth adoption among older adults.

Sensitivity analysis

To assess the robustness of the prioritization to panel-weighting assumptions, we conducted a one-at-a-time reweighting experiment over the 11 experts. The baseline scenario (S0) assigns equal weights to all experts. In scenarios S1–S11, one expert receives a weight of 0.25 while the remaining 10 experts share the residual 0.75 equally (0.075 each). For each scenario, we recomputed the aggregate BWM weights and induced ranks for all 25 criteria. Figure 2 presents the criteria weights across scenarios for the top-8 baseline criteria.

Overall, the ranking is stable. The baseline top five criteria remain within the top seven across all scenarios, and the baseline bottom-tier criteria remain in the lower ranks. In particular, C24 (Lack of Familiarity with Technology) is the most influential factor in the baseline (Rank 1) and remains Rank 1 in half of the scenarios (S0, S1, S7, S8, S9, S11), Rank 2 in most others (S2–S6), and never falls below Rank 4 (S10). C13 (Limited Computer Literacy or Technical Skills) is consistently top-tier, attaining Rank 1 in S2, S5, and S6, Rank 2 in S0, S8–S10, and never worse than Rank 4 (S7, S11). C23 (Health-Related Limitations) and C21 (Decreased Sensory Perception) remain within the top 6–7 throughout; notably, C23 reaches Rank 1 in S10 and C21 reaches Rank 1 in S4, reflecting expert-specific emphasis on health and sensory constraints.

Taken together, the sensitivity results indicate no policy reversals and confirm that managerial priorities derived from the baseline analysis are robust to substantial perturbations in expert weights. For implementation, this implies that investments in basic digital skills, familiarity-building, and health/sensory accommodations remain the highest-leverage actions across plausible expert-weight configurations. In contrast, usability/design enhancements can become first-order priorities in settings where design-oriented expertise leads the decision process.

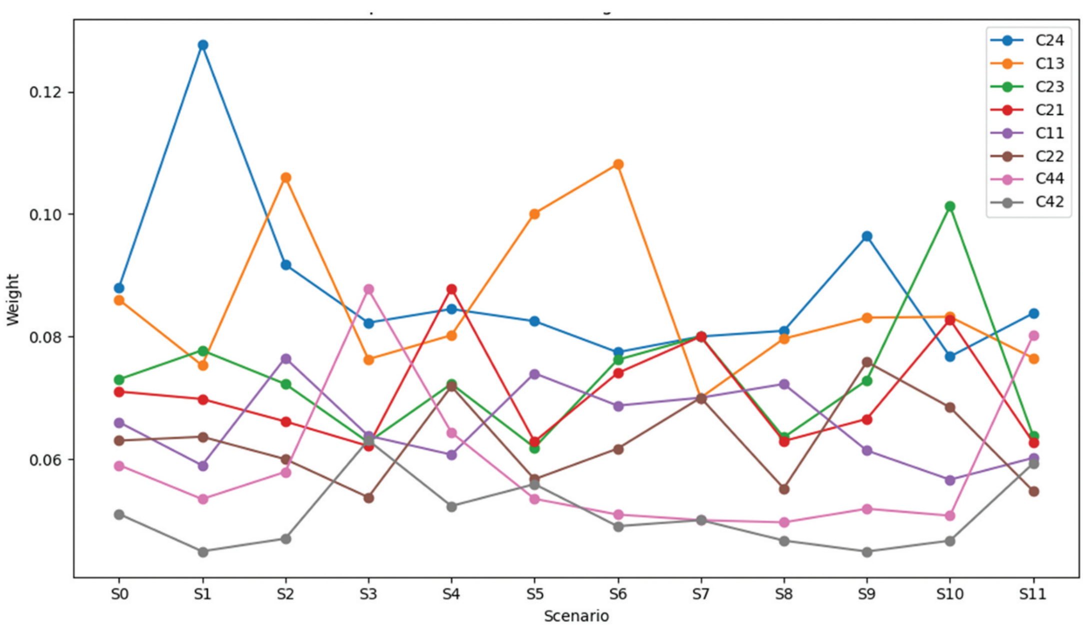

Figure 2. Weights for sensitivity analysis.

Discussion

This study employs a rigorous scientific approach to identify and prioritize the critical barriers and facilitators influencing mHealth adoption among older adults. A comprehensive framework is developed, categorizing these factors into five main criteria: "C1. Technological Capability and Confidence," "C2. Physical and Cognitive Limitations," "C3. Perceived Relevance and Need," "C4. Usability and Design Factors," and "C5. Economic Factors." Each of these main criteria is further detailed with specific sub-criteria. The Best-Worst Method (BWM) is utilized to ascertain the relative importance of these factors, leveraging expert evaluations from various domains. This method enhances the reliability of the findings by ensuring that the weights reflect a consensus among experts.

The analysis reveals that nearly 45% of the experts identified "C2. Physical and Cognitive Limitations" as the most significant barrier, while "C5. Economic Factors" were deemed the least critical. The decreasing relevance of economic barriers can be attributed to the widespread availability and accessibility of basic technological devices, making mHealth tools more attainable.[22] Consequently, physical and cognitive limitations, which encompass age-related declines, emerge as the most pressing challenges. "C1. Technological Proficiency and Confidence" is identified as the second most important criterion, highlighting the role of knowledge and self-assurance in technology use. This finding aligns with previous studies, such as Cajita et al.,[3] which identified a lack of technological knowledge as a key barrier to mHealth adoption.

Based on the evaluation of the sub-criteria, the most critical barrier to mHealth adoption among older adults is identified as "C24. Lack of Familiarity with Technology," with a final weight of 0.0880. These findings highlight that the primary challenge for older adults in adopting mHealth technologies is their unfamiliarity with digital tools and platforms.[23] This lack of familiarity often leads to anxiety and reluctance to engage with new technology, thereby impeding the effective use of mHealth services. The second most important sub-criterion is "C13. Limited Computer Literacy or Technical Skills," which is closely linked to the main criterion of "Technological Proficiency and Confidence." This sub-criterion emphasizes the critical role of basic technological skills in facilitating mHealth adoption. Without these skills, older adults are likely to struggle with even the most user-friendly mHealth applications, further widening the digital divide. Additionally, "C23. Health-Related Limitations," with a weight of 0.0732, ranks as another significant barrier. This sub-criterion reflects the physical and cognitive challenges associated with aging, such as declining vision, hearing, and memory, which can hinder the effective use of mHealth tools. The prominence of this sub-criterion underscores the need to design mHealth solutions that accommodate the physical and cognitive limitations of older users.[24]

Building on the highest-weight barriers that limited familiarity and skills with technology and health/sensory constraints. Three complementary actions are recommended for routine practice. First, implement staged digital literacy training for older adults that begins with a short needs assessment and proceeds through brief orientation, hands-on practice sessions focused on real mHealth tasks (e.g., medication reminders, vital-sign logging), and light ongoing support via refreshers or peer mentors. Second, require age-inclusive user-interface design in all procured or co-developed tools, including large, readable typography, high contrast, generous touch targets, plain language, simplified navigation with progressive disclosure, and forgiving error recovery with step-by-step onboarding. Third, integrate lightweight clinician cueing into routine care by adding a concise prompt for eligible patients, supporting clinicians with a short recommendation script, and providing a one-page quick-start (paper or QR) that patients can take home. These actions are low-burden, mutually reinforcing, and can be rolled out in parallel within existing clinical and community workflows.

The three recommended actions align with distinct decision owners within typical health systems. Staged digital literacy training is led by the clinic manager (planning, staffing, scheduling) and delivered by the patient-education team or community partners, with insurers supporting coverage or small incentives for participation and, where applicable, device subsidies. Age-inclusive user-interface requirements are primarily the responsibility of vendors and the clinic's procurement/digital health committee, who specify accessibility criteria in RFPs, conduct usability reviews before deployment, and request rapid revisions when barriers are detected; insurers can reinforce compliance by preferring tools that meet accessibility standards. Lightweight clinician cueing is owned by clinical leadership and the informatics team, who add brief prompts and scripts to routine visits; vendors provide the necessary templates and integration, while clinic managers ensure the workflow is adopted in practice.

The findings indicate that the most substantial barriers to mHealth adoption among older adults are inherently personal, stemming from physical, cognitive, and technological challenges. External factors, such as connectivity issues or reliance on technology, are perceived as less significant in comparison. Therefore, to enhance mHealth adoption, it is essential to address these personal barriers first. This may involve tailored training programs, user-friendly technology design, and ongoing support to build confidence and competence among older users. Health policymakers and/or health professionals should consider the importance of these factors for mHealth apps. By focusing on these areas, the digital health divide can be narrowed, and the benefits of mHealth can be more widely realized among the older population.

Conclusion

This study identifies and prioritizes the barriers and facilitators to mHealth technology adoption to increase its use among older adults, who could significantly benefit from these healthcare advancements. To achieve this, key factors influencing mHealth adoption are systematically analyzed using the BWM, a robust MCDM approach. Detailed main criteria and sub-criteria are defined, and these factors are ranked based on insights from a diverse group of experts, including doctors, health-focused academics, and psychological counselors. The findings reveal that the most critical obstacles to mHealth adoption are personal barriers, with physical and cognitive limitations identified as the most significant criterion. This underscores the importance of addressing individual challenges to improve mHealth adoption among older adults. From an implementation standpoint, healthcare organizations and technology developers can leverage these prioritized findings to focus on the most impactful barriers first, maximizing the effectiveness of mHealth adoption strategies for older adult populations.

This structured approach provides valuable guidance for designing and implementing more accessible and user-friendly mHealth solutions, ultimately contributing to better health management and overall well-being for older adults. The study also offers scientifically grounded results that can drive the increased use of mHealth technologies. Furthermore, the BWM-based framework presented in this study can be replicated in other healthcare settings to prioritize adoption factors, enhancing the generalizability of these results to various contexts. One limitation of this study is its reliance on expert opinion, which may introduce subjectivity in the weighting process of barriers and facilitators. Future research could explore the use of alternative MCDM methods and expand the criteria set to include a broader range of factors, potentially incorporating empirical data to enhance the robustness of the findings. Additionally, the approach suggests potential avenues for future research, such as exploring other MCDM methods and incorporating different criteria in the evaluation process, to further refine and expand upon these findings.

Although this study offers a robust and systematic approach, it does have some limitations. For instance, the proposed MCDM method relies on expert views. This research, being a single-case study reliant on expert decision, has inherent limitations. The subjectivity of expert contribution may affect the results' objectivity, and the results are most directly appropriate to regions or publics with similar contexts. Dissimilar socio-economic settings or a different expert panel might yield variations in the importance of factors or the final ranking. Additionally, incorporating the perspectives of older adults can help enhance the validity of the findings and ensure that the proposed strategies are both relevant and practical for the intended users of mHealth technologies.

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Availability of data and material

Not applicable

Consent to participate

Not applicable

Consent to publish

The authors confirm that the final version of the manuscript has been reviewed, approved and consented for publication by all authors.

Code availability

Not applicable

Disclosure statement

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Ethical approval

Ethics committee approval is not required.

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