

Identifying Unmet Needs of Community-dwelling Older Adults: A User-centred Design Approach of a Mobile Health Application

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ABSTRACT

Introduction: 'Population ageing' and 'ageing in place' are major challenges worldwide. To manage population ageing, it is crucial to fulfil the needs of elderly care. Digital health technologies have emerged to support the needs of Older Adults (OA). Mobile health (mHealth) apps are cost-effective digital tools to achieve health objectives. The unmet needs of community-dwelling OAs need to be identified and incorporated into the development of mHealth apps.

Aim: To identify the unmet needs of community-dwelling OAs by adopting the User-centred Design (UCD) approach.

Materials and Methods: The present qualitative study was conducted in 3 stages. In stage 1, the interview questions were framed for OAs, informal caregivers, and Healthcare Professionals (HCP). Two qualitative review rounds of these interview questions were conducted by 15 experts/HCPs. In stage 2, the interview questionnaires were translated into Hindi, and then both English and Hindi questionnaires were

pilot tested on five OAs and 5 informal caregivers. In stage 3, semi-structured interviews were conducted with 20 OAs and 10 informal caregivers. The interview responses were audio recorded or written. The recorded interview responses were transcribed verbatim. Thematic analysis of interview responses was conducted.

Results: Thematic analysis of interview responses resulted in 4 themes and 17 codes that indicated the unmet needs of OAs. The 4 themes included self-care, life essentials, work, leisure and social activity. These findings were incorporated into the design of the mobile app in consultation with a software engineer.

Conclusion: The present study established the utility of user involvement to identify the unmet needs among community-dwelling older individuals. Hence, the study guides researchers to include stakeholders in all stages of the creation of mHealth apps, particularly during the initial content development stage. The findings of this study provide input for designing an mHealth app to promote functional independence.

Keywords: Ageing, Elderly care, Mobile applications

INTRODUCTION

Ageing is a natural phenomenon experienced by every human being. The number of persons over 60 is increasing and is exceeding the number of younger individuals leading to 'population ageing' [1]. To overcome the challenges of population ageing, the World Health Organisation (WHO) promoted a public health framework known as "healthy ageing" [2,3]. Healthy ageing refers to the process of acquiring and retaining the functional skills required for well-being in later years [4]. Another concept of 'ageing in place' has gradually emerged over time. Many older individuals prefer living in their homes and communities instead of being institutionalised for care [5,6]. A major challenge in dealing with population ageing is to fulfil the needs of elderly, especially for those OAs who prefer ageing in place [7-9].

Literature indicates that community-dwelling OAs experience numerous unmet needs related to their daily functioning, social participation, and health [10]. An older individual may require assistance to perform basic daily tasks, including bathing, dressing, cooking, and grocery shopping. Such assistance may be in the form of a caregiver to help with self-care tasks or as an assistive technology device to complete the task independently. The gap between the need and availability of support due to lack of resources is regarded as an unmet need [10]. Technology is an important asset in addressing the issue of unmet needs among community-dwelling OAs [11]. With the advent of mobile phones, their use to achieve health objectives has evolved rapidly in the form of medical and healthcare practice known as mobile health (mHealth) [12]. Mobile applications (apps) are the most cost-effective form of mHealth. Despite their multiple uses, mHealth apps are not readily used by

OAs compared to younger individuals due to usability challenges such as age-related cognitive and physical limitations, low digital literacy, privacy/trust issues, user interface design issues, and misalignment with their real needs [13-15].

The International Organisation for Standardisation described usability as the extent to which a system, product, or service can be utilised by specific users to accomplish the stated goals with efficiency, effectiveness, and satisfaction in a particular context [16]. The usability challenges of mHealth apps emphasise the necessity of designing technological innovations in collaboration with the stakeholders/end-users. This approach of involving the end-users of the technological device throughout its design and development process is known as the UCD approach [17]. The UCD approach leads to the development of mHealth technologies that meet the actual needs of the end-user rather than focusing on needs that the end-user does not have [18]. UCD enhances the usability of an app by making it more understandable, easy to use, efficient, effective, and readily acceptable [19].

Existing evidence shows the availability of many mobile apps developed to support community-dwelling OAs. Big Launcher is an app designed for older people to simplify smartphone use by increasing the size of icons and text for them [20]. DigiAdherence is a video-based app developed to provide health-related knowledge to OAs living at home [21]. A review study summarised 15 smartphone apps developed for OAs focusing their physical/cognitive limitations and providing solutions to improve their quality of life [22]. The current mHealth apps do not specifically target the functional independence of community-dwelling OAs. However,

promoting their functional abilities is crucial to support the WHO's worldwide initiative of healthy ageing. A growing body of research in the field of mHealth also reveals that many researchers who developed mHealth apps for OAs involved the end-users of mHealth apps, i.e., the OAs, in the usability testing of the app, but not in the initial content development phase of the mHealth app. Hence, the aim of the the present study was to identify the unmet needs of the community-dwelling OAs using the UCD approach. This study is part of a PhD research project focusing on the design and development of an mHealth application for community-dwelling OAs to facilitate their functional abilities.

MATERIALS AND METHODS

The present qualitative study was conducted in the community settings of Delhi and Jaipur, Rajasthan, India, from October 2022 to October 2024. Ethical approval was obtained from the Institutional Ethics Committee (IEC) of the affiliating University, Jaipur, India (Number: MGMC&H/IEC/JPR/2022/911). The study was designed and reported in accordance with the Consolidated criteria for Reporting Qualitative research (COREQ) guidelines [23], and written informed consent was obtained from all participants. The study was undertaken in 3 stages.

Study Procedure

Stage 1: The existing literature on mHealth apps developed for older population was reviewed [24-28]. Open-ended interview questions were formulated for OAs and informal caregivers based on this literature review. The interview questions, comprising of 16 questions each for OAs and their informal caregivers, were reviewed qualitatively by an expert panel of 15 HCPs, including five medical practitioners (Physicians and Geriatricians), five occupational therapists, and five Physiotherapists. During the qualitative review, the experts reviewed the interview questions and provided their feedback on clarity and content areas covered. Based on their comments, changes were made to the questionnaires. Two questions were added to the questionnaires, and two were reframed to improve the clarity of the questions. The interview questionnaires for OAs and caregivers, each comprising of 18 questions, were finalised after two rounds of qualitative review and consensus of the experts. Additionally, using 12 interview questions framed for HCPs, the same expert panel was interviewed to obtain their views on the daily living needs and challenges of OAs based on their clinical experience.

Stage 2: The interview questionnaires were in English. It was decided to translate the questionnaires into Hindi to provide a language option to the participants, as many OAs in India prefer Hindi as a language of communication. The questionnaires were translated using the standard translation procedure, i.e., initially forward translation from English to Hindi followed by back translation from Hindi to English [29]. The final versions of the English and Hindi questionnaires were pilot tested on 5 OAs and 5 caregivers. The findings of pilot testing indicated that the participants could easily understand the questions and answer them appropriately. Therefore, no further changes were made in the questionnaires.

Stage 3: An interview is the most common method of gathering data, and its semi-structured form is the most often used interview approach in qualitative research, especially in the context of healthcare [30]. The primary benefits of the semi-structured interview include the ability to facilitate communication between the interviewer and the study participant, enabling the interviewer to build up additional probing questions for gaining in-depth information from the interview [30]. Hence, semi-structured interviews using the open-ended questionnaires developed through stages 1 and 2 were conducted with a purposive sample of 30 participants (20 OAs and 10 informal caregivers). Purposive sampling was used to select participants intentionally for maximising the variety of participants (by age, gender, or health status) to collect a diverse range of in-depth perspectives of participants focusing on the unmet needs

of elderly in daily living activities. Literature reveals that a qualitative study does not follow any one specific rule for sample size and it is not statistically calculated as in quantitative studies [31,32]. Sample size depends on what the researcher wants to know, the purpose of seeking information, and the extent of information received [31,32]. In the present study, the participants were recruited for interview till no new theme or code emerged and thematic saturation was achieved, that is, the stage where additional data did not produce any new information relevant to the study. The eligibility criteria of the interview participants are listed in [Table/Fig-1].

Study participants	Inclusion criteria	Exclusion criteria
Older Adults (OA)	Older persons aged 60 years or above Living in community settings Both genders - male and female Healthy older persons living in their homes	Older persons in institutional settings, such as hospitals or long-term care Older persons with communication impairment
Informal caregivers	Family member/unpaid/informal caregiver aged 18 years or above, providing care to community-dwelling OAs aged ≥60 years	Professional/paid/formal caregivers Persons with communication impairment
Healthcare Professionals (HCPs)	HCPs dealing with OAs (aged ≥60 years) in their current work role HCPs with minimum 2 years work experience so that they are familiar with the needs of OAs Either using or aware of mHealth technologies	HCPs not dealing directly with OAs (aged ≥60 years) in their current work role HCPs working only in administrative/managerial roles Neither using nor aware of mHealth technologies

[Table/Fig-1]: Eligibility criteria of the interview participants.

These interviews were focused on gaining in-depth knowledge of the unmet needs of community-dwelling OAs related to their daily living activities, from the perspective of both OAs and their informal caregivers, so that the solutions to achieve their unmet needs may be incorporated in the mobile app. The interview responses were audio-recorded or written down as per the consent of each participant. The audio recordings were later transcribed verbatim. Thematic analysis of the interview responses was conducted, which generated the domains of the unmet needs of OAs related to their functional independence. These domains formed the foundation of the content of the mobile app. The present study method aligned with the UCD approach, as the end-users of the mobile app are OAs, and they are either directly involved or the process is centred around them in every stage of the study.

STATISTICAL ANALYSIS

Descriptive statistics were used to describe the characteristics of participants recruited in 3 stages of the study. Thematic analysis of the participants' responses from the semi-structured interviews of OAs, informal caregivers, and HCPs was conducted using MS Excel [33].

RESULTS

The results derived in each stage of the study process are as follows:

Stage 1: In stage 1 of the study, the mean age and work experience of 15 HCPs involved as expert panel were 40.6±7.6 years and 15.53±8.44 years, respectively. Details regarding the characteristics of HCPs are presented in [Table/Fig-2]. Few changes were made to the questionnaires for OAs and informal caregivers after 2 rounds of qualitative review by HCPs. Two questions were added to both questionnaires, and two questions were reframed to improve the clarity of the questions.

Stage 2: In stage 2, the developed questionnaires were pilot tested on 5 OAs and 5 informal caregivers. The mean ages of the OAs and informal caregivers were 74+3.32 years and 46+7 years, respectively. During the pilot testing of the interview questionnaires, it was found that the participants could easily understand the

Characteristics	n (%)
Profession	
Medical practitioner	5 (33.3)
Occupational therapist	5 (33.3)
Physiotherapist	5 (33.3)
Age (in years) (Mean±SD=40.6±7.6)	
20-29	2 (13.3)
30-39	3 (20)
40-49	9 (60)
50-59	1 (6.7)
Gender	
Male	9 (60)
Female	6 (40)
Education level	
Graduate	2 (13.3)
Postgraduate	10 (66.7)
Doctorate	3 (20)
Work Experience (in years) (Mean±SD=15.53±8.44)	
0-10	4 (26.7)
11-20	5 (33.3)
21-30	6 (40)

[Table/Fig-2]: Demographic characteristics of Healthcare Professionals (HCP) involved in stage 1 (N=15).
Abbreviations: N=Total number of HCPs, SD=Standard Deviation

questions and answer them appropriately. Therefore, no further changes were made in the questionnaires.

Stage 3: In-depth semi-structured interviews were conducted, recruiting 20 OAs and 10 informal caregivers, using the questionnaires that were finalised after stage 2. The mean ages of the OAs and informal caregivers were 75.25±6.84 years and 49.8±8.48, respectively. Details regarding the characteristics of OAs and informal caregivers are presented in [Table/Fig-3,4], respectively.

Characteristics	n (%)
Age (in years) (Mean±SD=75.25±6.84)	
60-69	3 (15)
70-79	12 (60)
80-89	5 (25)
Gender	
Male	12 (60)
Female	8 (40)
Area of residence	
Urban	15 (75)
Rural	5 (25)
Education level	
Illiterate/No formal schooling	0 (0)
Schooling (up to class 10)	5 (25)
Schooling (class 11-12)	2 (10)
Graduate	9 (45)
Postgraduate	4 (20)
Occupation	
Employed	1 (5)
Self-employed	3 (15)
Homemaker	4 (20)
Retired	12 (60)
Unemployed	0 (0)
Chronic illness	
Yes	12 (60)

No	8 (40)
Mobile phone user	
Yes	20 (100)
No	0 (0)
Type of mobile phone used	
Keypad phone	3 (15)
Touchscreen phone	17 (85)

[Table/Fig-3]: Demographic characteristics of Older Adults (OA) interviewed in stage 3 (N=20).
Abbreviations: N=Total number of OAs, SD=Standard Deviation

Characteristics	n (%)
Age (in years) (Mean±SD=49.8±8.48)	
18-35	1 (10)
36-53	6 (60)
54-71	3 (30)
Gender	
Male	4 (40)
Female	6 (60)
Area of residence	
Urban	8 (80)
Rural	2 (20)
Education level	
Illiterate/No formal schooling	0 (0)
Schooling (up to class 10)	1 (10)
Schooling (class 11-12)	2 (20)
Graduate	7 (70)
Postgraduate	0 (0)
Occupation	
Employed	2 (20)
Self-employed	5 (50)
Homemaker	3 (30)
Retired	0 (0)
Unemployed	0 (0)
Mobile phone user	
Yes	10 (100)
No	0 (0)
Type of mobile phone used	
Keypad phone	1 (10)
Touchscreen phone	9 (90)

[Table/Fig-4]: Demographic characteristics of informal caregivers interviewed in stage 3 (N=10).
N=Total number of older adults;
SD=Standard Deviation

Thematic analysis of the interview data was conducted using a process of 6 steps: 1) The interview responses were read repeatedly for familiarisation; 2) Initial codes were generated from the statements of the participants; 3) The related codes were grouped and themes were searched among these groups; 4) Themes were reviewed before finalising; 5) Themes were defined and named clearly; and 6) Report of the analysis was written. The codes and themes that resulted from thematic analysis of the interview responses are presented in [Table/Fig-5]. Four themes, including self-care, life essentials, work, and leisure and social activity, were derived from seventeen codes.

Theme 1: Self-care

Most of the OA expressed their concern for performing everyday activities that involve taking care of their own bodies, such as dressing, eating, bathing, using the toilet, etc., OAs described problems faced by them in maintaining self-care routines:

Themes	Codes
Self-care	1. Bathing 2. Toileting 3. Dressing 4. Self-feeding 5. Hygiene & grooming
Life essentials	1. Mobility 2. Care of others 3. Communication 4. Financial management 5. Home management 6. Health management 7. Rest & sleep 8. Learning new tasks
Work	1. Employment 2. Retirement
Leisure and social activity	1. Recreation 2. Social participation

[Table/Fig-5]: Codes and themes resulting from thematic analysis of the interview responses.

"I am scared of falling while taking bath because of poor balance. I prefer sitting on a stool while taking bath instead of standing under shower." (OA3)

"Due to shaking of my hands, I cannot hold spoon properly while eating. Feel embarrassed to eat in front of others...also have problem in fastening buttons and tying laces" (OA10)

Caregivers (CG) highlighted the problems faced by the OAs in performing their self-care activities. "Older persons may need help of family members to dress themselves because of physical weakness" (CG6)

HCPs stressed the importance of promoting functional independence of OAs in their self-care activities. "Older individuals may not be able to perform their self-care independently due to limited joint motion and balance issues" (HCP7)

Theme 2: Life Essentials

Older individuals reported increasing difficulties in performing activities that they considered important to live independently at home and in the community, such as cleaning, cooking, washing, using transportation, handling money/finances, etc.,

"I tend to forget things and get confused in calculations. So, it is difficult for me to manage my savings" (OA5)

"I cannot drive and have difficulty in using public transport. I am dependent on my son to take me for shopping and anywhere outside home" (OA11)

A caregiver stated: "Older persons generally forget to take their medicines on time and this is not good for their health" (CG5)

HCPs expressed their concern about regular health monitoring of OAs. "Many OAs do not understand how to monitor their blood pressure and sugar levels using digital devices at home" (HCP11)

Theme 3: Work

Most of the OAs reported that they were retired and spent most of their time at home whereas few reported that they were working in a paid employment. Both described different problems.

"I am unable to sit for long hours at work. I feel tired very soon" (OA17)

"I feel bored and lonely. The day seems too long. Children are occupied in their own lives" (OA12)

A caregiver reported: "Older individuals sometimes find it difficult to cope up with the changes in their lives after retirement" (CG8)

HCPs highlighted the challenges that the older individuals face if they wish to continue with work in their old age. "The OAs may find it difficult to work efficiently and safely due to joint pains, vision changes, and memory issues." (HCP3)

Theme 4: Leisure and Social Activity

The OAs expressed their interest in engaging themselves in recreational activities and participating in social gatherings. However, they reported many age-related challenges for them to participate in these activities.

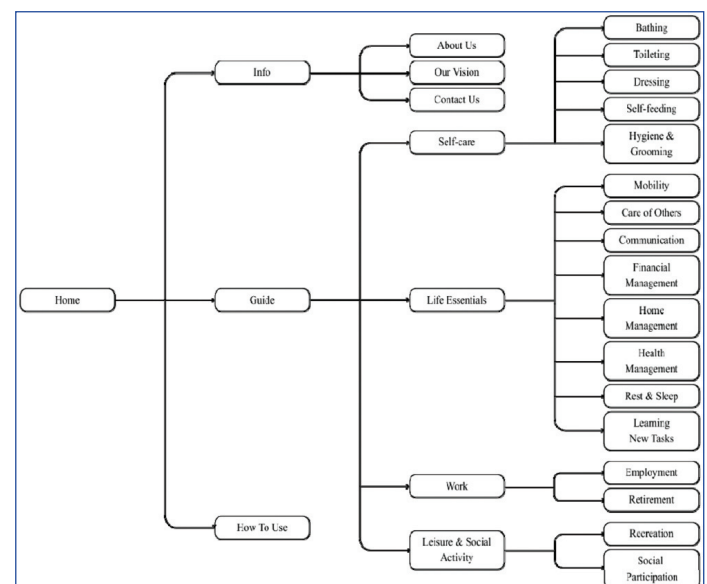
"I wish I could do knitting and embroidery as I used to do in my young age. I want to gift my own handmade items to my grand children but unable to do so because of poor vision" (OA16)

"I want to visit my friends to spend time with them, but since I cannot travel alone I am not able to meet them" (OA19)

Caregivers emphasised the involvement of older individuals in leisure and social activities for their mental well-being. "Older individuals avoid going to social gatherings because of mobility issues" (CG3)

HCPs highlighted the importance of leisure and social activities for OAs. "Older adults feel lonely and depressed because sometimes family members do not spend adequate time with them" (HCP8)

These codes and themes represent the unmet needs of OAs. The unmet needs of OAs identified through the study procedure are incorporated in the design of mHealth app in collaboration with a Software Engineer. An illustrative sitemap of the mHealth app depicting its buttons that the user would press to gain information is presented in [Table/Fig-6].



[Table/Fig-6]: Sitemap of the mobile health app.

The 'Home' screen of the app would guide OAs about the features present in the app so that they can use the app easily and efficiently. The findings of this study would form the foundation of the content that would be incorporated in the 'Guide' button of the app so that whenever the elderly users search for the solutions to the problems faced by them in performing daily living activities, the app provides them with an appropriate solution.

DISCUSSION

The present study provides a step-by-step procedure to identify unmet needs of community-dwelling OAs related to their functional abilities. The findings of the study also provide the domains for appropriate content development of an mHealth app to support the functional independence of OAs while living in their homes without being institutionalised for care. At every stage of the study, the stakeholders, i.e., OAs were consulted. This demonstrates the implementation of UCD approach in the design and development of an mHealth app. Literature emphasises that the mHealth innovations should be based on the needs of the end-users and not on the preferences of the creators [34,35]. As UCD helps to identify the real needs of the end-users, using the UCD approach increases the credibility of this research

study. Some researchers have employed similar approach in developing effective mHealth technologies to support older individuals [35-37]. A systematic review conducted by Fischer B et al., [38] examined the importance of user involvement, especially the engagement of OAs in the technology design. The authors reported three common consequences of involving OAs: facilitation of learning about their needs, an improved sense of participation, and enhanced quality of technology design due to their feedback [38].

Anarrative review study by Müller A and Schaaf J provides a framework for UCD interventions in populations that are vulnerable, such as OAs or individuals with disabilities [39]. Although conventional UCD approach strongly emphasises user involvement, this framework promotes co-design procedure that involves the healthcare providers and other relevant stakeholders along with the users to ensure inclusion of various perspectives in the design process of the technology [39]. In the present study, the informal caregivers and HCPs were recruited as study participants in addition to the OAs. The informal caregivers, generally being the family members of older persons, are aware of the needs and challenges of OAs in their daily living. The HCPs involved in the screening, evaluation, and treatment of older persons have experience in closely observing older persons. They have a clinical knowledge base that guides them to understand the real needs of OAs. Therefore, involving the caregivers and HCPs as study participants added valuable insight to the findings.

The four themes derived from thematic analysis of the interview responses align with the Occupational Therapy Practice Framework of the American Occupational Therapy Association (AOTA) [40]. AOTA published a framework in 2020 for Occupational Therapy Practice known as the Occupational Therapy Practice Framework Fourth Edition (OTPF-4). This provides the central concepts grounded in the occupational therapy practice. It also elaborates on the list of occupations or everyday activities that all human beings do as individuals, in families, and with communities. Thus, the linkage of the unmet needs of OAs identified through this study with the occupations mentioned in the existing framework, OTPF-4 of AOTA, represents a strong association between theory and practice.

The four themes identified in the study, including self-care, life essentials, work, and leisure and social activity, clearly indicate that these are major domains of life for an individual. OAs can achieve functional independence if they perform safely, securely, and independently in these four domains without the assistance of others [41]. This study facilitates the development of an mHealth app that would guide the methods and assistive devices/tools available for use by OAs so that they can become functionally independent in their home and community settings. This would promote 'ageing in place' and thus, reduce the burden on the healthcare systems that provide care to the OAs.

Limitation(s)

The number of participants recruited from the rural community settings was comparatively less than that from the urban community settings due to challenges in accessibility and recruitment of participants. This disparity may reduce the generalisability of the results across various geographical contexts.

CONCLUSION(S)

The study demonstrated the practicality and usefulness of user involvement in identifying the unmet needs of community-dwelling OAs. Hence, the study encourages researchers globally to incorporate stakeholders in all stages of the development of mHealth apps, especially in their initial content development stage. The study provides a robust methodology for the researchers to follow. The mHealth apps specifically targeting the unmet needs

of OAs can facilitate healthy ageing, improve quality of life, and decrease the overall burden on the healthcare system. The findings of the present study provide a foundational framework for the design and development of mobile health app that would guide community-dwelling OAs to manage their daily living activities independently or with minimal assistance.

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