Developing an ICT-Based Mental Healthcare Service Platform for Older People (IMPOP)

Euntaek Hong[1][a], Jueun Hwang[1][b], Dawoon Jung[1][c], Yong-Chun Bahk[1][d]
and Kee-Hong Choi[1,2][e,*]

[1]School of Psychology, Korea University, Seoul, Republic of Korea
[2]KU Mind Health Institute, Korea University, Seoul, Republic of Korea

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Abstract: Recently mental health issues of older people became a large part of society and the demand for elderly mental healthcare services is increasing. Non-face-to-face online mental health services are recommended because they can respond to psychological changes at an initial stage and are highly cost-effective. In Korea, there are few online services based on psychological evidence and considering the user experience of elderly users. This paper describes the overall 3-year production process of the ICT-based Mental Healthcare Service Platform for Older People (IMPOP). After preliminary interviews with practitioners and elderly users, we identified the primary mental health service demands of the elderly. Therefore, a single service platform considering the needs of the users and evidence-based tasks is designed. We present a detailed explanation of the developed modules of IMPOP. In the end, we discuss the implications of IMPOP and suggestions for the remaining research period.

1 INTRODUCTION

Life expectancy is getting longer worldwide, and the proportion of the elderly population is also increasing. The number of people aged 65 or older, which was 10 percent of the total population in 2022, is expected to increase to 16 percent by 2050 (United Nations, 2022). Korea is the fastest-aging country, with the elderly population exceeding 17% of the total population (Statistics Korea, 2022). This increment in the elderly population led to an interest in the quality of life and mental health of the elderly population. People in old age are known to have a high risk of mental health problems such as depression as well as physical health problems. Late-life depression (LLD) is the biggest problem in mental health in old age, especially, with about 7% of the total elderly population suffering from depression (WHO, 2017). In Korea, the depression experience rate of the elderly group was found to be the highest compared to other age groups (Korea Disease Control and Prevention Agency, 2019). Since the mental health problems of the increasing elderly population generate a lot of socioeconomic costs, prevention and initial responses to mental health in old age are becoming more important.

Especially, depressive episodes in older adults often appear as physical symptoms, which can easily occur due to other reasons rather than a depressed mood (Fiske, Wetherell, & Gatz, 2009; Husain-Krautter & Ellison, 2021). Therefore, depression is usually under-treated in the elderly. However, if LLD is not recognized and treated appropriately, it can lead to a functional disability and reduced quality of life (Husain-Krautter & Ellison, 2021; Katon, 2003). That is, continuous monitoring, prevention, and initial intervention are important for emotional problems in old age.

[a] https://orcid.org/0000-0001-7738-8769
[b] https://orcid.org/0000-0003-3791-9451
[c] https://orcid.org/0000-0003-4009-4112
[d] https://orcid.org/0000-0003-4216-5076
[e] https://orcid.org/0000-0002-7526-3329
*Correspondence: kchoi1@korea.ac.kr

Interestingly, online mental health service is suitable for monitoring mood changes and making an initial intervention. During COVID-19, interest and demand for non-face-to-face mental health services have emerged worldwide due to the spread of infectious diseases and social distancing (Wind, Rijkeboer, Andersson, & Riper, 2020). According to the review paper, many online mental health services have been developed; however, a few applications are evidence-based interventions (Larsen et al., 2019). However, online mental health services are not only helpful in disaster situations such as COVID-19 but also easy to be provided with high accessibility and low cost. Especially, it is useful for people who usually have difficulty accessing mental health services due to social, economic, or physical reasons such as older adults (McDonald, Eccles, Fallahkhair, & Critchley, 2020). Therefore, developing an evidence-based online mental health care service is an important task in our society.

In this paper, the overall development process of a senior mental healthcare service platform is described. Specifically, this paper presents the points that the research team considered in the development process, the advantages of the platform, and the plan for the rest of the research period.

2 RELATED WORK

2.1 Autobiographical Memory Training

Autobiographical memory refers to the recollection of specific events in a person's life, including details about the time and place in which they occurred, and the emotions associated with memories (Rubin, 2005). Less specific autobiographical memories are associated with increased feelings of depression and a tendency to engage in ruminative thought patterns (Lemogne et al., 2006; Kim et al., 2014). Research has demonstrated that one's ability to recall autobiographical memories tends to decline with age (Craik & Park, 2000), however, this can be mitigated through training.

Encouraging older adults to remember and discuss their autobiographical memories can improve their psychological well-being and stimulate cognitive function through the act of recalling memories (Yen & Lin, 2018). Reminiscence training such as autobiographical memory training was effective for elderly people with mild to moderate Alzheimer's dementia as well as for elderly people with depression (Jung, 2022; Raes et al., 2009).

2.2 Cognitive Training

Experts and researchers in various fields such as medical care, nursing, rehabilitation, elderly welfare, and social sports have developed various dementia prevention programs and have had significant research results so far. However, offline dementia prevention programs have limitations. A space for the program is essential, participants must visit there in person. If they cannot visit there continuously, the expected effect is lowered, and participation is limited if the participant has a physical disability. Therefore, using a smartphone-based dementia prevention app can be an alternative to compensate for the limitations of offline prevention programs (Kim & Choi, 2019). According to Yoon et al. (2014), the smartphone game application for diagnosis, prevention, and mitigation of dementia effectively suppresses brain cell reduction and an initial symptom of dementia, by performing mental activities of memory, logic, arithmetic, and spatial cognitive ability.

The most cognitive training apps are limited in their ability to evaluate and manage users' progress. Therefore, there is a need for a cognitive training app that can be continuously managed and evaluated based on data. The transfer effect, the degree to which the cognitive enhancements through the app lead to actual improvements, is crucial in evaluating the effectiveness of brain training apps. Studies have shown that repetitive training within the app may not always transfer to cognitive abilities in everyday life (Owen et al., 2010). It is important to consider the type of training, difficulty level, task context, and individual cognitive profile when assessing the transfer effect of a brain training app.

2.3 Mental Health Screening Tools

Screening tools to diagnose mental disorders are crucial in addressing the significant problem of mental health among older adults. However, the test tools currently employed in Korea are frequently used without undergoing a validation process. They are often imported by simply translating tools in Korean which are utilized in foreign countries. Additionally, since these tools are imported and translated into Korean, there is a limitation in that they may not effectively capture the unique characteristics of depressive symptoms that Koreans experience due to cultural differences. For this reason, this study used mental health screening tools for depression disorders (MHS:D) and mental health screening tools for anxiety disorders (MHS:A) to identify depression and

anxiety in the elderly population in Korea, overcome these limitations, and better reflect population-specific characteristics (Choi et al., 2019; Park et al., 2022).

The symptoms of depression were assessed using the Mental Health Screening Tool for depression disorders (MHS:D) (Choi et al., 2019; Park et al., 2022). The MHS:D is a 12-item self-report questionnaire using a 5-point Likert scale (0 = never; 4 = most of the time). The MHS:D exhibited a good internal consistency coefficient in this study (α = 0.94). Anxiety symptoms were assessed using the Mental Health Screening Tool for Anxiety disorders (MHS:A) (Choi, Lee, & Choi, 2019; Kim et al., 2021; Kim et al., 2018). The MHS:A is an 11-item self-report questionnaire using a 5-point Likert scale (0 = never; 4 = most of the time). The MHS:A exhibited a good internal consistency coefficient in this study (α = 0.96).

2.4 Considerations on the App

In designing apps for the elderly, vivid and high-chromaticity colors are important. Warm colors are easy for older adults to recognize and increase readability and distinguishability (Back, 2006). In addition, older people tend to prefer icons that feature 2-3 calm colors that they are familiar with because using a variety of colors for small icons can be perceived as complex or childish (Chung & Kang, 2020). To minimize information processing overload, the navigation depth of a single screen should not exceed three steps (Ministry of the Interior, 2017). Older adults tend to have reduced visual acuity compared to younger individuals and to stick to specific content for prolonged periods. When designing mobile devices, a letter size of 13-19pt is considered appropriate to ensure readability. However, seniors who use the Internet relatively well may not have much trouble with the small font size of 9-13pt (Hwang & Park, 2007).

2.5 Design on the App

The application was developed with careful consideration of the factors that are important when designing an application for older people. In this app, we used green and red, which are preferred by male and female seniors, respectively. In addition, a combination of icons and text was used to increase the ease of recognition. The main function was made larger than other icons. The UI used an easy and intuitive one-click indicator, not a double-click or drag that requires a sophisticated operation. By

creating a design that minimizes the amount of content displayed on a page, seniors focus only on the information they need and get confused less. Therefore, this application used 13pt and San serif typography to be read easily. In addition, an option was provided to change the screen font size in consideration of the elderly with severe vision deviation.

3 PRELIMINARY INTERVIEW

The team is developing an ICT-based Mental healthcare service Platform for Older People (IMPOP) to provide personalized non-face-to-face mental health services for the elderly in the community. To apply user-centered design to the platform, it is necessary to identify the mental health service demands of the elderly, the main target of IMPOP. In addition, it is also essential to identify the service needs of the elderly from the perspective of social workers who provide the service to older clients. In the first year of development, in-depth interviews were conducted with elderly users and elderly welfare providers.

For the preliminary interview, participants were recruited through convenience sampling for both users and workers. The inclusion criteria of the users were 65+years old and retired seniors who were members of the welfare center. All interviews were conducted online (via Zoom) for about 90 minutes. After a brief explanation of IMPOP, the participants freely answered the questions about the difficulties of mental health they had experienced and the elements that they would like to add to the platform. After hearing a brief explanation of the study, the participants provided responses freely about the mental health service demand of elderly users in the field and the functions they would like to add to the platform as case managers.

The mean age of the senior participants was 70.8(*SD=4.02*) years and the participants consist of 4 females and 2 males. Three were residents of the retirement village, and three were members of the senior welfare center. At the beginning of the interview, questions about the mental health issues they experienced as they grew older were asked. About half expressed concerns about the decline in physical health and cognitive ability that occurs in old age(*I feel tired and worried because my body gets sick as I get older*", "*I am worried about making decisions and judgments about things*"), and some participants complained of helplessness and loneliness after retirement (*"There is no one to share*

honest stories with", "I become helpless when I have nothing to work"). To cope with these, participants actively try to maintain their memory or create new relationships, but they experience limits (*"I learned various things and got along well, but it's hard to tell the deep story inside of me"*). Next, they were asked what elements would be good to be added if an application would be made. The most participants requested psychological services that emphasize positive contents such as vitality, laughter, and memories, rather than dealing with negative issues such as 'disease' or 'dementia' (*"Rather than aiming at healing disorders, it would be nice to create programs that find the fun", "It would be interesting to participate a program that helps remember good things rather than bad things"*). Also, there was a participant who said, *"We need a program 'rejuvenating the elderly', rather than a program stuck in the stereotype of the elderly"*. Participants stressed the need for an app allowing them to view information and interventions necessary for old age all at once.

The interview for practitioners was also conducted. Two are social workers working at to an elderly welfare center, and two are workers at an academy for the elderly. After the explanation of the platform, opinions were freely expressed about the service demands of elderly users, and their experience in the field as case managers.

Regarding the question about the demand for mental health services in the field, they answered that users' interests in social relationships and psychological concerns had grown in the non-face-to-face situation of COVID-19. However, there was an absolute lack of reliable mental health information and psychological experts in the field, so they highlighted that a platform providing professional services is needed in the field. They suggested that assessment programs be created in consideration of the characteristics of the elderly because it is often difficult for the elderly to read or understand the texts of the items. In addition, they emphasized that education for case managers about supporting elderly users who find it difficult to use smartphone apps is needed. Furthermore, in the case of users experiencing psychological crises, they said a service that can connect users to a mental health specialist more quickly is also needed.

To summarize, both elderly users and practitioners agreed that the demand for psycho-emotional services was increasing due to the non-face-to-face situation of COVID-19 and emphasized the need for mental health information and services specialized for older people. A notable demand from older users was that they wanted the platform to focus on the positive aspects of mental health and reflect 'young' senses to the design. Particularly pointed out by practitioners were the connection with experts through the service, and the provision of professional psychological assessment/intervention. The training led by practitioners was also emphasized so that users could use the platform usefully.

4 DEVELOPMENT OF IMPOP

The team IMPOP is developed to provide integrated psychological services for older people in the community. It will be provided through a stand-alone mobile application titled "Spring Again", which will be developed for use on Android platform. Figure 1 shows the brief information architecture(IA) of IMPOP.

Figure 1: Brief IA of IMPOP.

The research team designed the platform and content focusing on the experience of the elderly. When the texts are presented, voice-support functions are included so that elderly users with vision difficulties can easily read the contents. The team designed a single platform that provides various psychological services all at once. We included information and programs that remind one's meaningful memories and encourage spontaneous mental healthcare, which stresses older users' lively and cheerful life rather than their physical/cognitive declines. Below are the specific descriptions of the platform modules, composed of assessment and intervention, and methods offering personalized services.

4.1 Assessment Module

The emotional assessment module consists of three submodules: depression, anxiety, and vitality. Each submodule was created based on screening tools validated by Korean adult standards, such as MHS:D (Park et al., 2022) and MHS:A (Kim et al., 2021). MHS:V (Mental Health Screening Tool: Vitality, its validation process is in progress) is also included to measure one's vitality level, strongly related to psychological well-being such as satisfaction and security (Peterson & Seligman, 2004). When users work on a module for the first time, they are recommended to complete the whole module so that they can get the overall report of the emotional assessments. The cognitive assessment module is composed of four submodules: verbal memory (recognition), verbal memory (recall), attention, working memory, and logical memory. Like the emotional assessment module, this module is intended to provide cognitive assessments that can be conducted without experts.

After the first assessment, users can complete any submodules they want. According to the assessment, an easy-to-understand result report is provided so that users can accurately understand the results without an expert's explanation. Figure 2 shows the designed screen of assessments modules, an assessment item, and a result report.
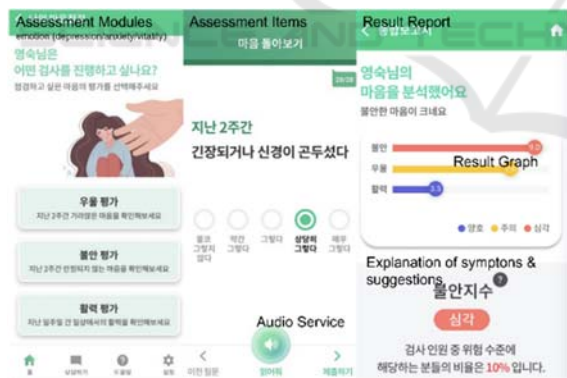

Figure 2: Screenshots of the assessment module.

4.2 Intervention Plan Model Using Assessment Results

When the user carries out assessment modules, an algorithm automatically recommends the order and difficulty of the module to the user according to the result of the assessment as illustrated in Figure 3. Prevention modules are automatically recommended for users whose results indicate that they are at the normal level of mental health (Case 1). When the report finds out that the user is in the mental health risk group, it is considered that the intervention with a mental health expert is urgent, and a guide text is printed so that they can directly get help from online or offline services (Case 3). For users who are on the mild to moderate level in one or more mental health issues, education and intervention modules fit for one's weak areas are automatically recommended (Case 2). For example, for a user whose attention score is relatively low, a game which is focusing on attention skills ('number in order') is shown on her/his recommendation list. Its difficulty level is also set according to the score of the previous assessment.
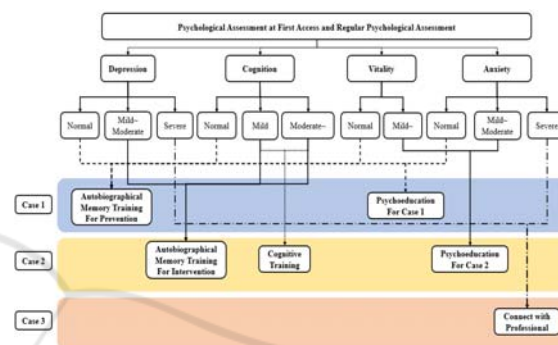

Figure 3: Summarized plan model of IMPOP.

4.3 Intervention Modules

Various intervention programs have been developed and included so that users can run customized programs on their own without the help of mental health professionals. There are four intervention modules: psychoeducation, autobiographical memory training, cognitive training, and non-face-to-face counselling.

In the psychoeducation module, the materials include psychological information about the emotional and cognitive characteristics of the elderly and a brief introduction to various psychological services included in IMPOP. Users may be educated to increase their insight into their psychological concerns such as depression and anxiety and motivate them to participate more actively in treatment and prevention programs on the platform.

The autobiographical memory program module was developed based on autobiographical memory training (AMT), a training program proven to effective in improving depressive symptoms and cognitive function. Its effect has also been verified for the elderly. The existing AMT should be conducted under the guidance of mental health professionals, but the program in the module was organized so that people could engage in training on their own without

the guidance of an expert. For users to understand the quality of their autobiographical memories and create accurate memories, it was designed to calculate scores on memories recorded by algorithms developed by the research team. A growth-type character, which grows as the number of training and the quality of memory increases, was used for users to be motivated to repeat the training and experience a sense of accomplishment. Figure 4 shows the app screens of the AMT module.

Figure 4: Screenshots of AMT module.

The cognitive training module is based on evidence-based face-to-face cognitive training. The program provides instructions on the training and content with high accessibility so that users can use it without an expert's guidance. The cognitive training program is provided in the form of a game, and users may carry it out with the level of difficulty suitable for the previous cognitive assessment/training score. Like the cognitive assessment, the module consists of four submodules (attention, working memory, logic memory, and verbal memory).

For special situations that require non-face-to-face help from mental health professionals such as crisis intervention, a non-face-to-face counseling module (mental health professionals) is provided on a 1:1 basis, and users can receive help from experts by linking the module if necessary.

Users may use the modules following the recommendation algorithm that provides the order of the modules or may directly select the modules and run the program that they want.

5 CONCLUSIONS AND FUTURE WORKS

This paper describes the need for non-face-to-face psychological services for the elderly and the development process of IMPOP. The senior user-experience-oriented design was applied to the entire platform, and psychological assessment and intervention modules specialized for the elderly were loaded into the platform. Development of IMPOP is underway with a total three-year plan and this is the end of the second year. In the first year, the team established the outline of service development, did preliminary interviews with potential users, and reviewed the outline. In the second year, detailed modules and the main platform were developed, and the preliminary implementation of IMPOP was carried out. In the final year, the field test of IMPOP will be conducted, the development of educational manuals for social and mental health workers, and the dissemination and utilization of IMPOP will be carried out.

Implications of the platform are as follows: First, an age-friendly digital mental health platform is developed. Now the penetration rate and usage time of smartphones among the elderly are increasing, but they are alienated from the digital market due to the app content/design focused on the younger generation. IMPOP applies an elderly-friendly design in the app, and it is expected that an elderly individual will be able to become an independent user.

Second, IMPOP extends the coverage of the elderly welfare system by strengthening the mental health aspect of the existing elderly integrated care service. To date, welfare services for the elderly have focused on the immediate problems (physical and cognitive decline in old age, economic insecurity, isolation), but they paid less attention to psychological difficulties (i.e., depression) occurring in the aftermath of well-known challenges. IMPOP may be provided in connection with existing welfare services, thereby meeting the elderly's needs for mental health services highlighted due to COVID-19.

Third, the platform is developed as a single mobile app that can provide personalized assessment/intervention services at once. Existing non-face-to-face mental health services provide 'one-size-fits-all' programs rather than considering individual characteristics. Many of these lack evidence and non-evidence-based mental health apps may cause harm to users (Baumel et al., 2020). Based on the overall results of users' assessments, IMPOP provides personalized and integrated program combinations tailored to the individual. In addition,

this platform consists of prevention and intervention programs based on evidence-based techniques used in clinical settings. It is expected that elderly users in the community will be able to use integrated and specialized mental health services on their own.

Further work includes developing a manual of IMPOP for welfare providers. The team plans to provide education to social workers in welfare centers for the elderly, which explains how to use the platform and interpret the result of the emotional/cognitive assessments. We plan to provide follow-up training on support for community centers that need additional help or want the connection to other experts. As a result, the basic understanding of the provision of psychological services for elderly welfare-related personnel will be enhanced.

Additionally, we plan to conduct a field test to verify the effectiveness of IMPOP. The effectiveness of the online assessments will be checked by measuring the internal reliability, test-retest reliability, criterion validity, and construct validity of each submodule. Based on a recent meta-analysis study conducted on depressive and anxiety disorders (Andrews et al., 2018), the size of the therapeutic effect of online psychological intervention compared to the control group was reported as $g = 0.80$. Considering the effect size of the study, a total of 64 people will be required to participate in the study until follow-up evaluation.

Lastly, to increase the utilization of services in the field, specific strategies for disseminating and utilizing the service in the field should be set out during the platform development process. We will establish agreements with various elderly welfare centers and local governments specialized in senior caregiving. If the IMPOP service model succeeds to relate to local governments and carries out integrated mental healthcare for seniors in the community, it can be a nationwide non-face-to-face mental health caregiving model for the elderly.

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