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The Development of Screening Application of the Risk of Elderly with Dementia in Saraphi District, Chiang Mai Province

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Abstract

This research aimed to develop dementia screening tools through a mobile application for use by public health volunteers and medical personnel in an attempt to detect the risk of dementia at early stages in Saraphi district, Chiang Mai province and to explore the satisfaction of the application users towards the implementation of a dementia screening application. The sample group was 90 public health volunteers residing in Nongphueng sub-district, Yang Noeng sub-district, and Saraphi sub-district, and 15 medical personnel working in Ban Nongphueng Tambon health promotion hospital, Yang Noeng Tambon health promotion hospital, and Saraphi hospital, Saraphi District, Chiang Mai Province. The research methodology comprised eight steps as follows: 1) conducting documentary research on dementia symptoms, screening tools, and dementia data from medical personnel at the Chiang Mai Neurological Hospital. 2) carrying out a field study with community participation to investigate the circumstances of dementia in Tambon Nong Phueng, Tambon Yang Noeng, and Tambon Saraphi. 3) selecting 90 public health volunteers, and 15 medical personnel to participate in this research. 4) formulating a storyboard which described the application model 5) designing the system and create the application with the consultancy from a psychiatric doctor for the elderly and an occupational therapist. 6) testing the operation of the application and carry out the improvement. 7) preparing the manual 8) publicizing and making the application available. The data collection instrument consisted of a satisfaction questionnaire towards the implementation of an application for dementia screening. The statistics used in the research were mean and standard deviation.

The dementia application, named "Brain Screening," was developed using the Flutter software development kit and the Dart programming language. It operates on the Android operating system. This application consists of four cognitive assessments: the 14-question item memory assessment, the Mini-Cog assessment, the 8-question item IQCODE-Modified assessment for relatives or caretakers to assess memories, and the AMT assessment for public health and medical personnel. Additionally, the satisfaction assessment of public health volunteers regarding the application's implementation yielded high levels of satisfaction, with an overall mean of 4.19 and a standard deviation of 0.53.

Keywords: Dementia, Elderly, A dementia screening tools based on mobile application

Introduction

Dementia is a neurological condition resulting from gradual and continuous damage to brain cells, leading to cognitive abnormalities and the loss of short- and long-term memories (Kanagawa, 2006). In Thailand, the prevalence of dementia patients has been steadily increasing due to the changing demographic. According to the National Statistical Office of Thailand (2022), the number of dementia patients was 600,000 in 2015, and it is projected to rise to 1,117,000 by 2030 and 2,007,000 by 2050. Since 2005, Thailand has officially become an aging society with a growing number of elderly individuals, making dementia one of the five chronic diseases among the elderly today (Nanthachai, 2008). As the condition progresses, individuals with dementia often require 24-hour supervision and assistance, significantly impacting their ability to perform daily tasks. Additionally, dementia also affects caregivers in various ways, including personal sacrifices, increased stress, and financial burden (The Alzheimer's Disease and Related Disorders Association, 2011). Ultimately, these factors can worsen the quality of life for both caregivers and patients. One of the most effective ways to mitigate the severe consequences associated with dementia is early identification of patients in the early stages, which aids in memory rehabilitation, slows down brain degeneration, and promotes normal or near-normal brain function (Anandirokrit, 2021).

Nowadays, the healthcare sector is adopting technological advancements to offer improved personalized healthcare services to the general public. One groundbreaking and popular innovation in this field is the use of mobile-based solutions and application technology. This revolutionary technology aids in the better management of patient care and enables efficient diagnosis. Its significance in the healthcare industry cannot be overstated, as it enhances communication and integration throughout the healthcare process. This, in turn, boosts the productivity of healthcare providers and the healthcare system as a whole (Ventola, 2014). In Thailand, mobile app technology is crucial in the process of evaluating, identifying, and providing medical care for individuals. Many scholars have developed a range of applications for the field of healthcare services, including the diabetic monitoring mobile application, the application for health check-up system, an application entitled 'Thanrok' to manage health problems of ethnic groups in Chiang Dao district, the 'Smart Caregiving' application to support caregivers of persons with mobility disability, and the Chatbot application to answer questions about medical technologists" (Sirimongkollertkul et al., 2020; Lawang et al., 2018; Arunsirot et al., 2023; Sanmun et al., 2021).

In Chiang Mai province, the number of aging population has rapidly increased, and one of its geographical limitations is the distance from the sea. There are several factors that affect the occurrence of dementia in elderly local residents, including sex, education level, social factors, health condition factors, and health behavior factors (Khruithong, 2010). During an interview with one of the family caregivers of people with dementia, it was revealed that other factors contributing to the prevalence of dementia in the province are long-distance problems between residences and neurological hospitals, as well as an inadequate number of medical specialists, leading to difficulties in accessing healthcare services (Suthep Arunsirot, personal communication, March 12, 2019). Consequently, the majority of individuals with dementia tend to visit the doctor once the symptoms become more apparent, indicating that they have reached the middle stage of the condition, for which there is currently no cure. These obstacles have become a preliminary cause for an instant assessment and analysis of the risks faced by patients in the early stage.

As part of Thailand's health policy, it is important to improve and promote the health of citizens of all ages, especially those who are disabled, underprivileged, and elderly individuals (Ministry of Social Development and Human Security, 2023). Therefore, the objective of this research is to develop a mobile application-based dementia screening tool that can be utilized by both public health volunteers and medical personnel. The benefits of using mobile dementia screening tests include quick evaluation, convenience, unlimited access, and data storage. This application will enable public health volunteers to systematically screen for dementia at an initial level. Additionally, the scores obtained from the dementia screening application, which are stored in the database system, will allow medical personnel to monitor the progression of dementia and provide the best treatment and personalized care for each patient. By conducting rapid and thorough screening for dementia in its early stages, the impact of the condition on the elderly can be reduced, making it more manageable, slowing down its degeneration, and ultimately decreasing complications and fatality rates. Furthermore, early-stage dementia diagnosis can alleviate the caregiving burden on caregivers and family members, effectively manage the behavioral and emotional issues of patients, and alleviate the strain on state-run hospitals that may not have the capacity to accommodate a large number of chronic patients (Chunin, 2004).

Research Objectives:

1. To develop dementia screening tools based on a mobile application used for public health volunteers and medical personnel in attempt to detect the risk of dementia at early stages in Saraphi district, Chiang Mai province**.**
2. To explore the satisfaction of the application users.

Methodology

Population and Sample Group

The sample group consisted of 90 public health volunteers residing in Nongphueng subdistrict, Yang Noeng subdistrict, and Saraphi subdistrict, Saraphi District, Chiang Mai Province, as well as 15 medical personnel working in Ban Nongphueng Tambon health promotion hospital, Yang Noeng Tambon health promotion hospital, and Saraphi hospital. The purposive sampling method was applied to select the participants. The criteria for inclusion were that they could be either male or female who owned Android smartphones and were willing to cooperate until the end of the research project with the research team.

How to conduct research

The research process could be divided into 2 phases as follows:

Phase 1: Investigating the circumstances of dementia and developing dementia screening tools based on mobile application used for public health volunteers and medical personnel

1.1 The researcher conducted documentary research on dementia symptoms, screening tools, linguistic theories, and dementia data from medical personnel at the Chiang Mai Neurological Hospital

1.2 The researchers submitted the letter of approval from Chiang Mai Rajabhat University to the mayors of the three municipalities.

1.3 The researchers met the mayors and heads of the elderly association in order to inform them about the research objectives, data collection methods, and their collaboration for collecting the data.

1.4 The researchers carried out a field study with community participation to investigate circumstances of dementia in Nongphueng subdistrict, Yang Noeng subdistrict, and Saraphi subdistrict.

1.5 90 public health volunteers with residing in Nongphueng subdistrict, Yang Noeng subdistrict, and Saraphi subdistrict, Saraphi District, Chiang Mai Province and owning the Android smartphones were recruited as the sample group in this research.

1.6 A storyboard was formulated, which described the application model that presented four cognitive assessments. They include the 14-question item screening assessment for public health volunteers to assess cognitive problems and for literate individuals to assess by themselves; the Mini-Cog assessment to evaluate cognitive problems, planning and relational dimensions; the eight-item IQCODE-Modified assessment for relatives or caregivers to answer about patients' memories and management; and the AMT screening tool for medical and public health personnel to assess patients' perceptions on time, place, person, attention, and memory.

1.7 Design the system and create the application with the consultancy from a psychiatric doctor for the elderly and an occupational therapist.

1.8 Its content was verified and assessed for content validity by three experts. It was found that the content validity index was at the highest level (Mean = 4.78, S.D. = 0.05).

1.9 The development of the application was designed based on five steps of the System Development Life Cycle (SDCL). The steps include a needs analysis, application component analysis/development roadmap/flowchart construction, user interface design, application development, and application tryouts and improvement. The process flow diagram was illustrated in Figure 1.

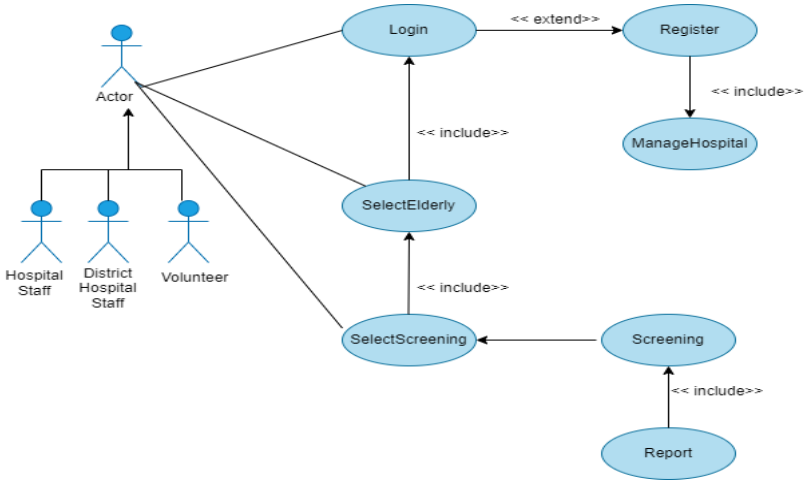

Figure 1 The process flow diagram of the screening application (Source: Researcher, 2023)

1.10 The application was verified and assessed for its quality by three computer experts. The overall technical properties of the application was at the high level (Mean = 4.40, S.D. = 0.17).

Phase 2: Implementing dementia screening tools based on mobile application used for public health volunteers and medical personnel

2.1 The workshop was conducted to educate 90 public health volunteers and medical personnel how to use the application for screening measured by the risk of dementia in primary care including the 14-question item screening assessment for public health volunteers to assess

cognitive problems and for literate individuals to assess by themselves; the Mini-Cog assessment to evaluate cognitive problems, planning and relational dimensions; the eight-item IQCODE-Modified assessment for relatives or caregivers to answer about patients' memories and management. Moreover, the medical personnel received training on the utilization of an additional screening test named "AMT screening tool" for medical and public health personnel to assess patients' perceptions on time, place, person, attention, and memory.

Figure 2 Educate how to use dementia screening tools based on mobile application used for public health volunteers and medical personnel in Saraphi District (Source: Research, 2023)

2.2 The questionnaire was constructed to examine the satisfaction of the users with the implementation of the application. It consisted of 5 sub-topics: contents of the application, beauty on design and arrangement of user interface, language, the system utilization on application functions by users, and system utilization in other aspects.

2.3 The manual and infographic were prepared for the application users in order to instruct and guide them on technical procedures.

2.4 The researchers publicized and made available the application through Google Play.

Data Analysis

The study was administered to the application users as a questionnaire to measure level of users' satisfaction with the use of dementia screening tools based on mobile application used for public health volunteers and medical personnel. Therefore, the questionnaire was analyzed to determine the mean and the standard deviation of the questionnaire items, based on Likert scale questions that measured satisfaction levels ranging from highest to lowest. The satisfaction levels of this application users were interpreted as follows:

4.50 – 5.00	Highest
3.50 – 4.49	High
2.50 – 3.49	Moderate
1.50 – 2.49	Low
1.00 – 1.49	Lowest

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Results

Construction of the application for preliminary screening the elderly with a tendency to have dementia

The dementia application, named "Brain Screening," was developed based on the flutter software development kit and the dart programming language. It operates on the Android operating system and is available for download from Google Play, as shown in Figure 3.

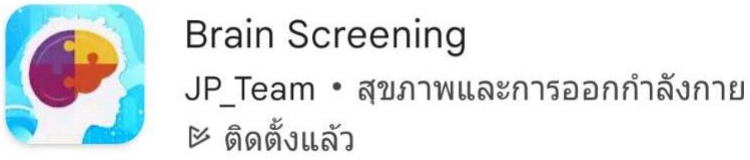

Figure 3 The icon of the dementia screening application in Google Play (Source: Research, 2023)

1. The registration and log in system

When the system is in operation mode, users are able to log in using their personal accounts that have been approved and granted by the administrator. The login process begins by entering the telephone number used for registration. For first-time users, the administrator will require them to create their own passwords to authenticate and confirm their registrations. Once this is done, the system will direct them to the homepage to re-verify their registrations by entering their passwords. If the registration details are correct, they will be able to access the system, as illustrated in Figure 4.

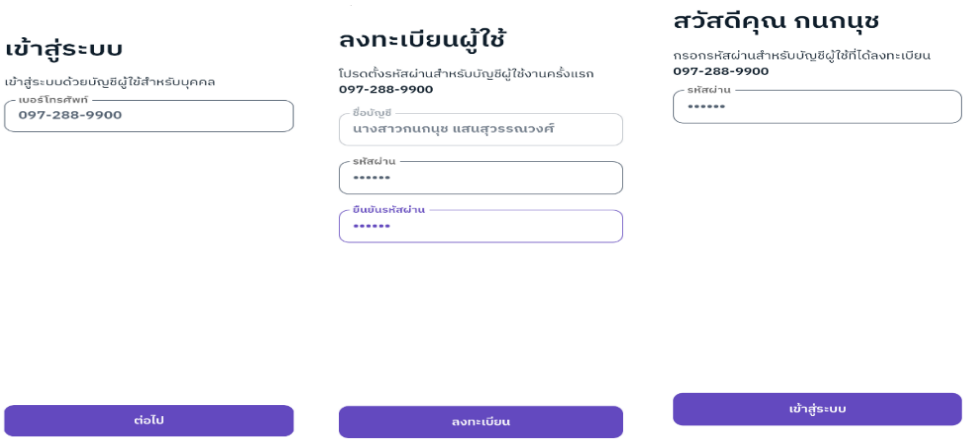

Figure 4 The screen for registration and log in (Source: Research, 2023)

When users are already in the system, they can access and display their personal information, affiliated hospital information, Tambon health promoting hospital information, and information about patients under medical care, as shown in Figure 5

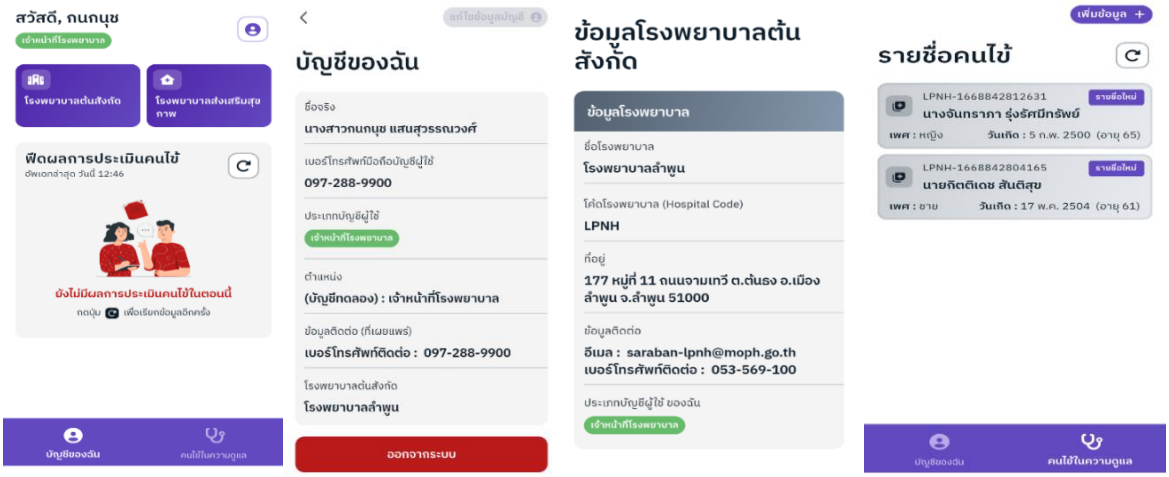

Figure 5 The user profile of the screening application (Source: Research, 2023)

2. Dementia screening tools based on mobile application used for public health volunteers

For public health volunteers, three initial screening tools were selected to create Dementia screening tools through a mobile application. These tools include the 14-question item screening assessment, the Mini-Cog assessment, and the eight-item IQCODE-Modified assessment. The 14-question item screening assessment is designed for public health volunteers to evaluate cognitive problems, while literate individuals can assess themselves using this tool. It consists of 14 items with a four-point rating scale. The Mini-Cog assessment is used to evaluate cognitive problems, planning, and relational dimensions. On the other hand, the eight-item IQCODE-Modified assessment is meant for relatives or caregivers to provide information about the patients' memories and management. The screens for these assessments can be seen in Figures 6a-6c, respectively.

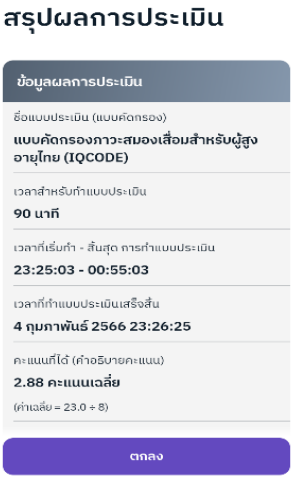

Figure 6a.The 14-question item screening assessment **Figure 6b**.The eight-item IQCODE-Modified assessment (Source: Research, 2023) (Source: Research, 2023)

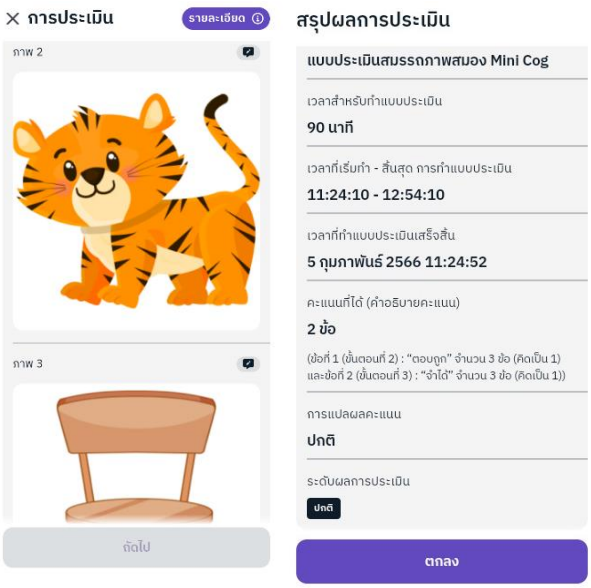

Figure 6c. The Mini-Cog assessment (Source: Research, 2023)

3. Dementia screening tools based on mobile application used for medical personnel

Besides the three screening tools mentioned above, an additional screening test named the AMT screening tool for the assessment of brain conditions is chosen for medical personnel. It consists of 10 points and is used for rapidly assessing elderly patients for the possibility of dementia (Lazarou et al., 2021). The screens for the assessment are shown in Figures 7.

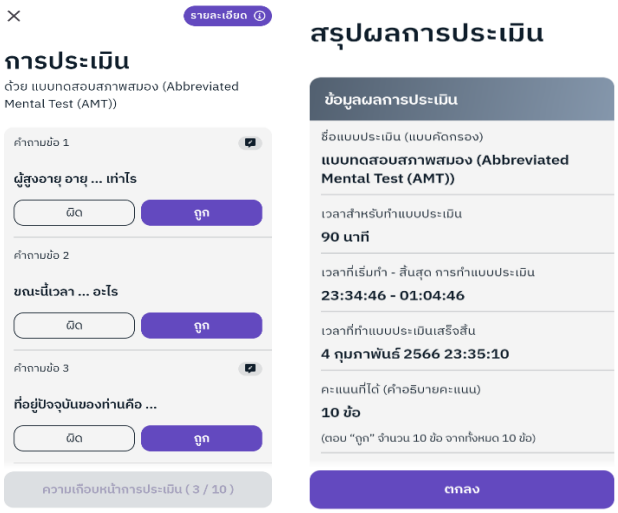

Figure 7 The AMT screening tool (Source: Research, 2023)

Additionally, the evaluation menu enables medical personnel to monitor the progress of individuals with dementia by presenting the scores of each assessment. The screens are displayed in Figure 8.

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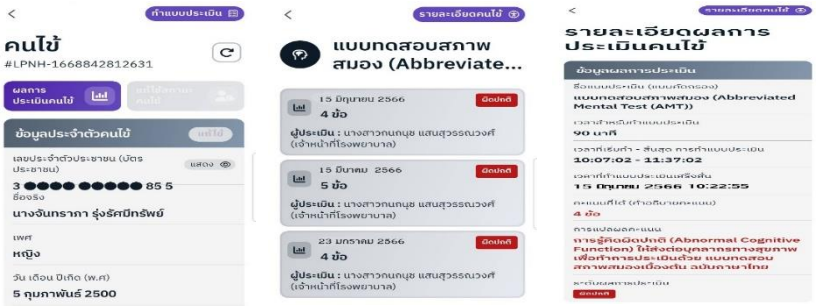

Figure 8 The evaluation menu (Source: Research, 2023)

The satisfaction results of the public health volunteers toward the application for preliminary screening the elderly with a tendency to have dementia.

After the development of the application, it was implemented by 90 public health volunteers and 15 medical personnel. The assessment results on their satisfaction with the application are summarized in Table 1.

Table 1 The assessment results on satisfaction with the application of public health volunteers and medical personnel

Description	Quality Level		
	Mean	**S.D.**	**Level**
1. Contents of the application			
1.1 The contents are correct and complete.	4.26	0.56	High
1.2 The contents are consistent with the needs.	4.12	0.53	High
1.3 The contents are easy to understand.	4.00	0.56	High
1.4 The contents are practical.	4.12	0.52	High
1.5 The obtained information is useful.	4.00	0.56	High
Total	**4.10**	**0.55**	**High**
2. Beauty on design and arrangement of user interface			
2.1 The interface design is appealing for use.	4.00	0.52	High
2.2 The interface design is user-friendly.	4.00	0.52	High
2.3 The interface design focuses on convenient information exchange among users.	4.12	0.56	High
2.4 The interface design enables users to easily access information in all menus.	4.12	0.56	High
2.5 The fonts and icons are suitable.	4.66	0.48	Highest
2.6 Background and font colors are suitable for reading.	4.44	0.50	High
Total	**4.22**	**0.52**	**High**
3. Language			
3.1 Language use is correct.	4.12	0.52	High
3.2 The language is easy to understand.	4.00	0.56	High
3.3 The language is suitable for users.	4.00	0.55	High
Total	**4.04**	**0.54**	**High**
4. The system utilization on application functions by users			
4.1 The application operates correctly.	4.36	0.48	High
4.2 The data processing is operated quickly.	4.00	0.52	High
4.3 Application file size is appropriate.	4.02	0.71	High
4.4 The application is easy to use, not complicated.	3.86	0.53	High
Total	**4.06**	**0.56**	**High**
5. System utilization in other aspects			
5.1 The application is beneficial.	4.36	0.48	High
5.2 The application is practical.	4.62	0.49	Highest
5.3 The application is innovative, different from other applications.	4.56	0.50	Highest
Total	**4.51**	**0.49**	**Highest**
Average	**4.19**	**0.53**	**High**

From Table 1, it is summarized that the overall satisfaction of the participating public health volunteers and medical personnel with the implementation of the application for preliminary screening of the elderly with a tendency to have dementia was at a high level, with a mean of 4.19 and a standard deviation of 0.53.

Additional recommendations from the application users include:

- The application should include sound to read the question items of the assessment tools, making it easier for public health volunteers who may have difficulty reading.
- The screening assessment uses a clear and easily readable font size. However, the instructions for the screening need to be appropriately designed to ensure that application users can easily understand the messages.
- The application should be developed for smartphones running the iOS operating system.
- The sequence of scores, which correlates with the progression of dementia in patients, should be presented in the form of charts or diagrams. This will help medical personnel track and monitor their patients' symptoms easily.

Discussions

This research focuses on developing dementia screening tools through a mobile application. The aim is to detect the risk of dementia at early stages among public health volunteers and medical personnel in Saraphi district, Chiang Mai province. The mobile application, called "Brain Screening," was created using the Flutter software development kit and the Dart programming language. It is compatible with the Android operating system. The application includes four cognitive assessments: a 14-question memory assessment, the Mini-Cog assessment, an 8-question IQCODE-Modified assessment for relatives or caretakers to evaluate memories, and an AMT assessment for public health and medical personnel.

Furthermore, it was found that the satisfaction of the participating public health volunteers and medical personnel with the implementation of the application was at a high level, with a mean of 4.19 and a standard deviation of 0.53. This is because the five-step development cycle was applied during the development of the application. The five steps are composed of an analysis of problems and needs, analysis of application components/system development roadmap/flowchart construction, user interface design based on needs, application development, and implementation and improvement of the application. This corresponded with Boonchum et al. **(**2020**)** that application development based on SDLC is systematic and sequential, resulting in standard efficiency of the system and effectiveness of use**.** The advantages of the implementation of the application in smartphones for screening are speed, reliability, convenience, flexibility, and time saving for processing and calculating for score intercept. Moreover, the research results of Kallander et al. (2013) confirmed that apps for dementia screening offer a multitude of advantages in settings with limited logistic, financial, and time resources. These apps have the potential to significantly reduce costs, decrease the need for highly trained personnel, shorten the time to diagnosis, and improve patient outcomes. Additionally, the screening apps can function as a facilitating instrument for healthcare workers in resource-limited countries who lack the necessary expertise to conduct neuropsychological assessments for dementia.

Furthermore, the application is able to store the personal data of each elderly person in each screening, which is beneficial for medical personnel to accurately and concretely diagnose the stages of dementia. This will result in better and more efficient treatment planning. This is

in line with Pornudomthap et al. (2022), revealing that the application for caring elderly dementia patients via the Android operating system in smartphones was able to efficiently improve the daily activities of patients due to its reliability and convenience, leading to the reduction of anxiety and care burdens. Additionally, Arunsirot et al. (2023) noted that the development of the healthcare application on smartphones was a guideline for accessing basic public health services due to distance problems. This is due to the fact that access is quick and limitless and it is to bring modern technology to lessen medical burdens efficiently. It is a part of fulfilling a public health gap and driving system development and mechanisms that facilitate the elderly to access and get healthcare services concretely. In addition, technological advancement was exploited for the ease of daily activities, enabling users to use the application efficiently, flexibly, and in response to their needs without restrictions of time and place. Also, it was consistent with Ahmad & Dirar (2013) who developed the application run on Android smartphones to improve the quality of Alzheimer patients' lives by focusing on slowing the progression rate and increasing their abilities to participate in the surrounding environment and society. It is therefore concluded that mobile phone technology plays a vital role to help the quality of treatment for dementia patients which leads to reduce a burden to not only the patients themselves but also caregivers who support them in their daily activities.

Conclusion and suggestions

Dementia screening tools based on a mobile application used for public health volunteers and medical personnel were constructed to run on a smartphone operated on the Android Operating System. It consisted of four cognitive assessments: the 14-question item memory assessment, the Mini-Cog assessment, the 8-question item IQCODE-Modified assessment for relatives or caretakers to assess memories and for public health volunteers for management, and the AMT assessment for public health and medical personnel. However, it should be developed on the smartphones with the IOS operating system. Also, more operating functions connecting with concerned public health agencies should be added. Additionally, the application should be developed further, disseminated, and publicized to the elderly in the Upper Northern region with similar contexts.

New knowledge and the effects on society and communities

This "Brain Screening" application is used for preliminary screening the elderly with a tendency to have dementia in Saraphi district, Chiang Mai province. It should be developed further, disseminated, and publicized to the elderly in the Upper Northern region with similar contexts in an attempt to prevent or reduce the prevalence of dementia. When the condition is discovered at an early stage, treatment, and rehabilitation can be more effective and efficient, which would bring about a sustainable improvement of the quality of life of the elderly.

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