Development of a touchscreen-based nutrition learning tool to promote healthy eating practices among early elderly Thai people

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ABSTRACT

Introduction: In Thailand, rapid demographic ageing is closely linked to an increased incidence of non-communicable diseases (NCDs). Effective nutritional management is essential to mitigate NCD risks and delay progression. Given the widespread use of touchscreen devices among older adults, this study focused on developing a nutrition app tailored to enhance knowledge, attitudes, and practices regarding healthy eating among Thai elderly people. **Methods:** The project consisted of two main phases, namely content preparation and application development. Initial drafts and storyboards were refined through consultations with experts and discussions. The use of healthy menus was approved by a professional chef and nutritionists. The app prototype underwent comprehensive evaluations in terms of content accuracy, design, usability, and acceptability by experts. It was also field tested by elderly volunteers for four weeks. **Results:** The developed "YoungYou" app features tools such as body mass index assessment, updates on elderly health, and dietary recommendations tailored to Thai elderly individuals based on the nutrition flag system. It includes 60 healthy recipes, 30 cooking tutorials, and an interactive community board. The app allows users to modify and recalibrate the nutritional content of recipes, which can then be saved or shared. Evaluations of the app showed high levels of agreement on its effectiveness across all metrics. The use of rice, vegetables, and meat by 41 elderly volunteers led to increased healthy eating behaviours. **Conclusion:** The "YoungYou" app has demonstrated potential as a viable tool for promoting healthier eating habits among Thai elderly people, thereby addressing critical public health issues related to ageing and disease prevention.

Keywords: elderly people; healthy eating; nutrition app; tool development; touchscreen

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INTRODUCTION

The elderly population is continuously increasing worldwide, including in Thailand (Foundation of Thai Gerontology Research and Development Institute, 2020; United Nations, 2019). Thailand is an ageing society, with 20.2% of its population being elderly in 2023 (Thailandometers, 2023). These individuals face several alterations, such as decreased metabolism and appetite, as well as sensory and chewing abilities (Nifli, 2018; Krause *et al.,* 2023). Health problems, particularly non-communicable diseases (NCDs) related to nutrition, such as type 2 diabetes, hypertension, cardiovascular disease, and cancer, have also increased (National Health Examination Survey Office, 2021). This increase in health problems coincides with the rise in health service demand. People entering early advanced age (60-69 years) face a major transitional period (retirement transition), which has potential benefits and drawbacks. Some potential benefits include having more free time to engage in hobbies, recover physical health, and adopt a more active lifestyle (Eibich, 2015). In contrast, without adequate retirement planning, people aged 60 to 69 years may face financial challenges due to the loss of a steady income, thus affecting their ability to maintain their lifestyle and afford health care.

Substantial evidence confirmed that a healthy diet could lower the risk of NCDs and postpone their severity (Marcello & Sara, 2020; World Cancer Research Fund International, 2014). Healthy diets commonly include high nutrient-dense foods, high-fibre foods, low energy-dense foods, low-processing foods, and less seasoning, especially sugar, salt, saturated fats, and trans fat (Marcello & Sara, 2020; Sirichakwal, 2017; WHO, 2015). Furthermore, specifically for Thai elderly people,

there is a nutrition flag that considers their unique nutritional requirements and common health challenges such as NCDs (Bureau of Nutrition, 2018). The nutrition flag is a guideline that outlines specific recommendations on daily intake quantities for various food groups, including grains, vegetables, fruits, meat, and dairy, tailored to the needs of elderly individuals at each level of energy requirements according to their activities. Recommendations about hydration, sleep duration, physical activities, and nine qualitative guidelines are also added. Although there are several products of food modification to promote health and nutrition among elderly individuals or healthy diet recipes that are disseminated through various channels, such as cookbooks, online webpages, online clips, and smartphone applications. There are limitations nevertheless, such as limited food product choices, and not accounting for the complicated health conditions of the elderly. Some elderly people have difficulty navigating digital platforms, especially online information, and difficulty reading small font sizes. Information can also become quickly outdated, not reflecting the latest nutrition research or dietary guidelines, especially for printed information.

Many studies have indicated that the use of information and communication technologies (ICTs) by elderly people has a positive impact on their physical and emotional communication, social connectivity, and ability to successfully self-manage their health (Henriquez-Camacho *et al.,* 2014; Sun *et al.,* 2016). Moreover, touchscreen devices are the easiest source of health information, making the promotion of healthy lifestyles and nutrition possible through the use of touchscreen-based applications (Bert *et al.,* 2014). Nutrition applications can improve nutrition knowledge, attitudes, eating behaviours,

and nutritional status among elderly people, e.g., WeSihat (Ali *et al.,* 2012) and Nutrihealth (Salim *et al.,* 2017) for the Malaysian elderly, as well as Appetitus for the Norwegian elderly (Aure, Kluge & Moen, 2021). Often, the health and nutrition information available to elderly people is generic and does not account for the wide variety of dietary preferences, cultural specificities, or availability of food products in different regions. The other limitation is that there are no characteristics of popular social networking, which has proven engagement and retention (Vandelanotte *et al.,* 2016). Health and health care information is the type of content Thai elderly people need and they expect it to strengthen their potential for healthy behaviours. Highly popular social media platforms should consider the elderly population during health media development, as well as their unique limitations, such as visual impairment or not being proficient at tapping on small screens without a zoom function (Sap-in & Khaoroptham, 2017). Furthermore, there is a lack of self-learning tools and technology focusing on healthy food and nutrition for Thai elderly people.

Therefore, this was a great opportunity to develop a touchscreen-based nutrition learning tool to promote healthy eating among Thai elderly people. This application was developed based on academic information, designed to be user-friendly and attractive, utilising the valuable functions of a touchscreen device, and suitable for Thai elderly people. Its ability to promote healthy eating among elderly volunteers is also reported.

MATERIALS AND METHODS

This study was conducted in two main parts: (i) information preparation, and (ii) application development. The application development process is shown in a diagram in Figure 1.

Part I: Related information preparation

Step 1 Reviewing of related information
Information related to the topics of interest, including: 1) elderly health and nutrition and their alterations; 2) food recommendations for Thai elderly individuals; 3) healthy foods and ingredients, particularly those used by Thai elderly people to fix their health problems; 4) food preparation and cooking in terms of methods, techniques, and sanitation, which are suitable for elderly people; and 5) application design, which is suitable for elderly people, were reviewed. Then, an initial screening was performed; only suitable articles, text, and any kind of sources of information, such as the application store, were collected. Their key information and findings were extracted, matched to each interesting topic and applied to this study. Experts in nutrition, education, and media and communications were recruited by considering their experiences, reputations, and contributions to the field. The most appropriate method(s) chosen for consultation depended on each expert's availability, such as electronic file mailing, printed mailing, or verbal consultation. The experts were consulted using detailed briefs, questionnaires, and the type of feedback needed, which was actionable and relevant. The feedback from all experts was analysed; common recommendations and areas of concern were identified. Then, the feedback was integrated into the development process, and the content, design, and functionality of the nutrition learning tool were refined.

Step 2 Drafting of content and storyboard
The draft was constructed from the review of related information and expert consultation. The draft of content consisted of: 1) healthy diet information;
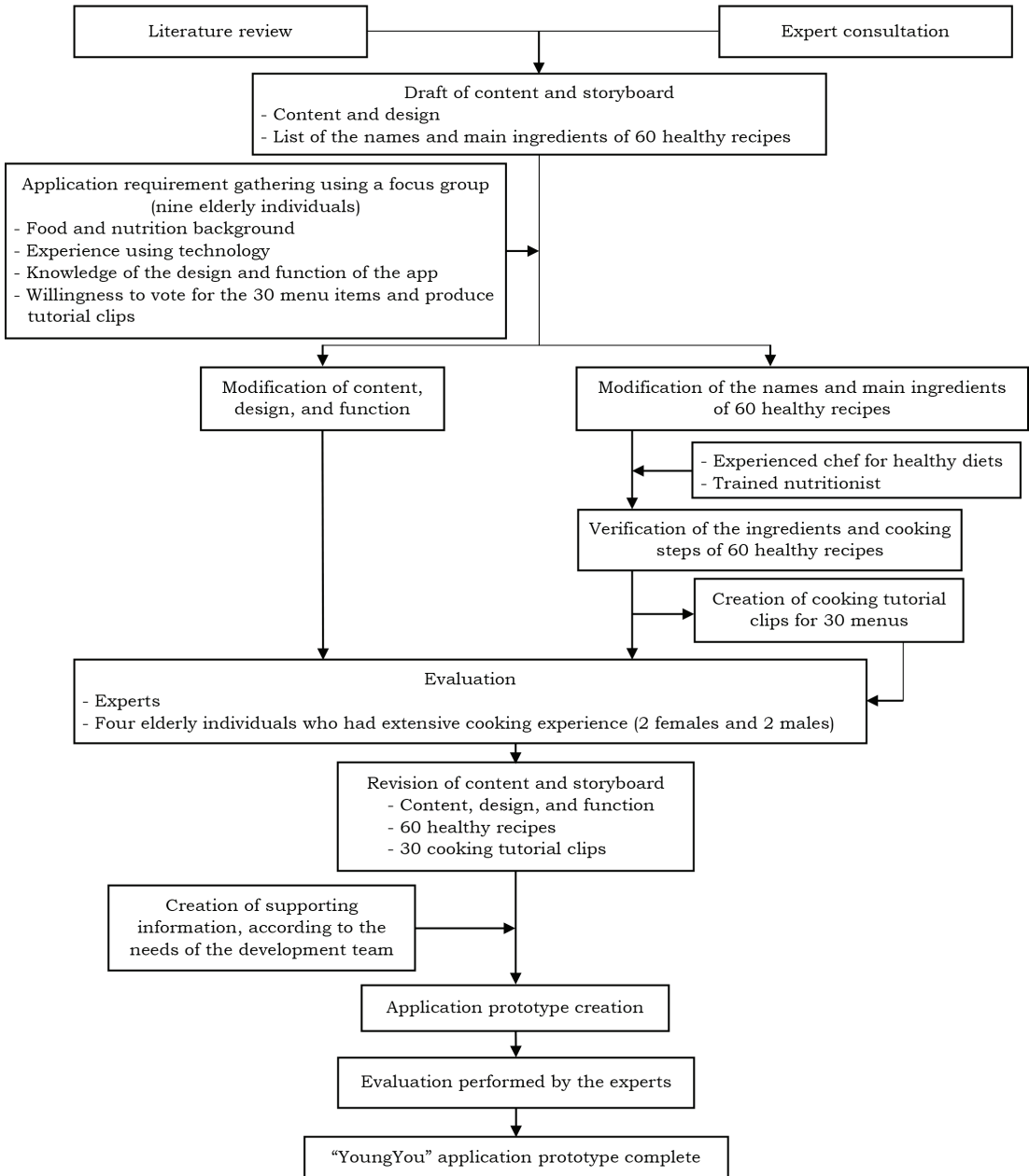
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┌────────────────────────────┐          ┌────────────────────────────┐
│     Literature review      │──────────│    Expert consultation     │
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Draft of content and storyboard
- Content and design
- List of the names and main ingredients of 60 healthy recipes

Application requirement gathering using a focus group
(nine elderly individuals)
- Food and nutrition background
- Experience using technology
- Knowledge of the design and function of the app
- Willingness to vote for the 30 menu items and produce
  tutorial clips

Modification of content,
design, and function

Modification of the names and main ingredients
of 60 healthy recipes

- Experienced chef for healthy diets
- Trained nutritionist

Verification of the ingredients and cooking
steps of 60 healthy recipes

Creation of cooking tutorial
clips for 30 menus

Evaluation
- Experts
- Four elderly individuals who had extensive cooking experience (2 females and 2 males)

Revision of content and storyboard
- Content, design, and function
- 60 healthy recipes
- 30 cooking tutorial clips

Creation of supporting
information, according to the
needs of the development team

Application prototype creation

Evaluation performed by the experts

"YoungYou" application prototype complete

Figure 1. The application development process

2) cooking conversion chart; 3) healthy recipes; and 4) an adaptable function for recommended healthy recipes. The storyboard was developed by drawing all structures using a basic computer programme, as shown in Figure 2 (a-c). A description of each menu function was also provided to explain to users how each menu works after tapping on it. The storyboard explained how the
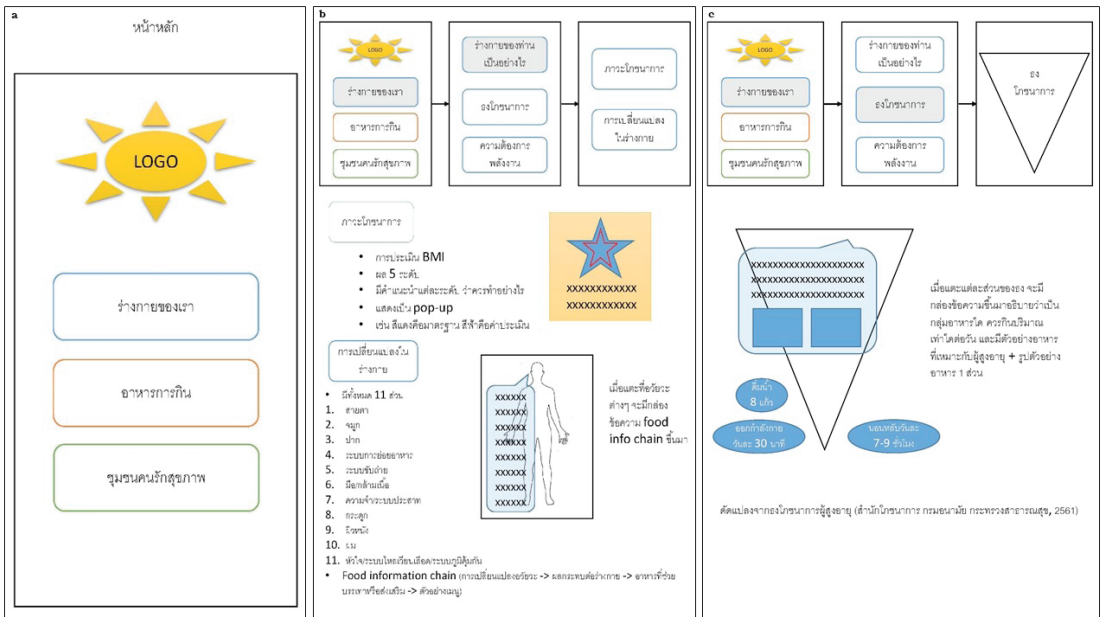
Figure 2 (a-c). A storyboard example

application works to a focus group and the application developer team.

Step 3 Gathering of application requirement

All needs and requirements about content and design were gathered from nine elderly individuals in a focus group who were selected by purposive sampling according to their experiences with technology and cooking. The participants were aged 60-69 years who had used a smartphone or tablet for more than one month and were able to access the internet. They read, understood, and communicated in the Thai language, and were able to cook and modify recipes.

A focus group was held in a private meeting room for one hour. The researcher was the moderator, posing questions, keeping the discussion on track, and encouraging the participants. Research assistants were note-takers. The purpose of the focus group and its benefits to participants and the community were explained in the first session. Verbal

informed consent was obtained. A semi-structured guideline interview was conducted with open-ended questions on three aspects: 1) food and nutrition background; 2) experience of technology use; and 3) design of content, art, and function using the storyboard. In the last session, they discussed 60 healthy menu lists and voted for 30 menu items to be developed as cooking tutorial clips.

After the draft was modified, it was evaluated by the experts. Then, each evaluation topic that had areas of improvement or had to be considered before being delivered to the application development team was revised to ensure that it was appropriate for Thai elderly people.

Step 4 Developing healthy recipes and cooking tutorial clips

Healthy recipes were initially developed by listing the names and their main ingredients; then, they were discussed in a focus group and modified to follow the elderly people's experiences

and food preferences. The healthy food information chain was applied to link the health benefits of healthy food to health problems in elderly individuals, which was then linked to healthy ingredients that are rich in such health benefits, and finally linked to healthy recipes that contain the relevant healthy ingredients. Each menu had a unique concept of health concern, such as constipation, bone strength, vision improvement, low-sodium, low-fat, low-sugar, etc. Food preparation and cooking processes were based on food sanitation principles aimed at preventing foodborne illnesses. The steps of cooking were ordered so that users could easily follow step by step. Then, all modified healthy recipes were verified by a chef experienced in developing healthy diets, trained nutritionists, and researchers to adjust the steps of food preparation and cooking, the amount of ingredients, and the taste of the finished dishes. These procedures were conducted to maximise acceptance by consumers, to ensure that food preparation and cooking steps were appropriate and safe for elderly individuals, and to remain aligned with healthy eating guidelines. Then, the nutritive value of each menu was calculated by IMMUCAL-Nutrient V.3 (Institute of Nutrition, 2013), using all the ingredients and dividing it by the number of servings to determine the nutritive value of each serving.

Throughout the cooking process, pictures of each ingredient, finished dishes, and video records were obtained for further use in the application. Verified healthy recipes and cooking tutorial clips were evaluated by the experts and four elderly people who were highly experienced in cooking (two females and two males) in terms of content, usability, and acceptability of the recipes. The design aspect was added to the cooking tutorial clip evaluation. A 5-point Likert scale from 1 to 5 (1 = less agree, 2 = partially agree, 3 = moderately agree, 4 = very agree, and 5 = extremely agree) was used in the evaluation and participants could also freely state their comments on both evaluations. Their comments and suggestions were used to revise the healthy recipes and cooking tutorial clips before use.

Part II: Application development
The application prototype was developed based on the revised version in terms of content, healthy recipes, and cooking tutorial clips under the concept of a user-friendly design suitable for elderly people, including the following:

Structural design
This study focused on knowledge about healthy foods and nutrition for Thai elderly people, healthy menus, and a sharing area for users utilising the valued functions of touchscreen devices.

Graphic design
Many graphics were created to transform the storyboard into colourful interactive graphics. An interactive function was also applied. For instance, the nutrition flag has quite complicated advice on how to eat foods in each of the six main food groups; therefore, the storyboard, as shown in Figure 2 (c) was developed into colourful graphics in Figures 3 (b) and (c), where users could tap into each food group to explore more details. Examples of a list of healthy foods and pictures of one serving were shown on a pop-up screen.

Interface design
Design was done as simply, easily, and smoothly as possible for each element of content and the use of each function. The main menu was placed at the sidebar, ensuring that all menu interfaces were consistent. Zoom and interactive functions, simple command directions, large font sizes, and graphics

were applied. Touch buttons taller than 9.0 mm and avoiding flexion-extension movement (Xiong & Muraki, 2016) were also used. High contrast colours and colours in soft pastel shades, which are suitable for elderly people (Atkinson, 2004), and warm colours, which are suitable for stimulating appetite (Braam, 2020), were also applied.

According to programme stability, the application was developed for use on the iOS operating system. During application development, design and function testings were repeated until the application worked smoothly and met the elderly individuals' requirements. The prototype application was installed on the experts' own iOS device and they had tried to use all functions by themselves before completing the questionnaire. The evaluation of content included its alignment with the objectives, appropriate content sequence, and the content language being accurate and appropriate for elderly individuals. Evaluation of design included whether it had an appropriate font size, font style, illustration size, colour, layout, interactive function, and in-app cooking tutorial clips. Evaluation of usability included accuracy of linking commands, difficulty of each function, and convenience to view while cooking. Evaluation of acceptability involved elderly people's opinions about the application's ability to promote healthy eating and their willingness to recommend the application to others. Each question used a 5-point Likert scale and an option for free comment was included. Participants' comments and suggestions were used to improve the application.

The application prototype was tested for four weeks by elderly volunteers who were recruited via electronic invitation posters. They were aged 60-69 years old, communicated in Thai language, smartphone or tablet owners, able to access their devices with the iOS operating system, and those whose devices could access the internet. The volunteers were required to be able to cook and modify recipes to conform to their food preferences and health conditions. The participants' healthy eating practices were measured both quantitatively and qualitatively. In the quantitative aspect, a three-day food record was used and comparison was done before and after using the application. Improvement was interpreted based on compliance with the nutrition flag among the elderly. The qualitative aspect considered eating practices related to the nine qualitative guidelines. An increase in score indicated that the participant's eating practices improved after using the application.

This study was conducted according to the guidelines of the Declaration of Helsinki and all procedures involving research study participants were approved by the ethics committee of the Faculty of Public Health, Mahidol University (Bangkok, Thailand; Reference: COA. No. MUPH 2019-005; approved 8 January 2019). Verbal and written informed consents were obtained from all participants.

RESULTS

According to the focus group discussion, elderly people's experiences with food and technology were considered when modifying the content, design, and function, as well as healthy recipes and cooking tutorial clips. The elderly people widely stated their background in food and nutrition; they preferred steamed vegetables and dippings, and tried to avoid carbohydrate sources such as white rice and white sugar since they were nearly 60 years old. Some of them ate only half as much food as they did when they were younger. This may affect nutritional adequacy. Therefore, the recommended amount of food per

day was added to the household units in each food group to elaborate the nutrition flag. Moreover, all participants used their smartphone or tablet every day, often more than once per day, and their devices maintained continuous internet access. The participants were quite proficient in the basic functions of touchscreen devices, such as typing, zooming, and taking photos. They also searched for health information through search engines, but never downloaded health-related applications. These findings supported the development and design of touchscreen nutrition learning tools.

For the development of healthy recipes and cooking tutorial clips, the amount of some ingredients, preparation and cooking period, serving size, and finished dish decoration were adjusted if needed under the considerations of the chef, trained nutritionists, and researcher in the verification process. The healthy recipes included six groups of Thai food menus: 1) appetiser/salad/spicy salad; 2) side dish (soup, steamed, grilled, or microwave roasted); 3) single dish from noodles; 4) single dish from rice; 5) dessert/bakery; and 6) hot drink/cold drink. Each group contained ten menu items for a variety of food ingredients and various health problems among Thai elderly people. Most of the experts and elderly people evaluated "extremely agree" on the usability of healthy recipes and cooking tutorial clips, and "very agree" on the content and acceptability of the 60 healthy recipes. For cooking tutorial clips, most evaluated "extremely agree" on the content and acceptability, and "very agree" on usability and design. This information was further delivered to the application development team.

The application prototype "YoungYou" was operational on iOS platform version 12 onwards. It could be used both offline and online. Users only had to access the internet while using functions such as watching cooking tutorial clips and sharing or posting on the community board.

The content structure consisted of three sections as follows:

1. Health and nutrition information related to the elderly population, consisting of the following:

    1) Body mass index (BMI): Users can input their weight and height after logging in and receive initial health care suggestions that are specific for each BMI level.

    2) Alterations or changes in some important organs in elderly individuals are linked to foods; nutrients that could decrease elderly people's health problems are linked to suggested healthy menus (Figure 3a).

    3) Nutrition flag for Thai elderly with details of suggested consumption amounts for each food group, examples of healthy food list, and example pictures of one serving (Figures 3b and c).

    4) The food recommendations for Thai elderly in each energy requirement subgroup were based on their sex, activities, and milk consumption. Healthy eating guidelines were provided in the table as amount per day in household units for six main food groups, including rice/starch, vegetables, fruits, meat/beans, milk, and oil/seasoning.

Health and nutrition information were displayed as colourful interactive graphics. Users could tap on the graphic and then receive details via a pop-up screen (Figure 3).

Figure 3 (a-c). Example of colourful interactive graphics
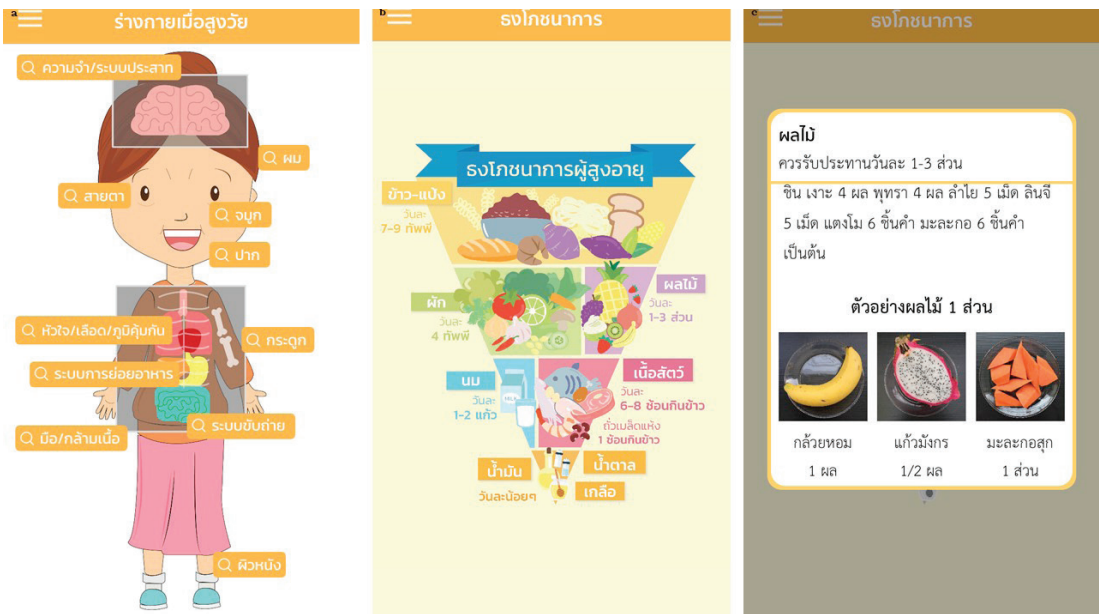
2. Healthy diet, consisting of the following:

   2.1) Introduction of ingredient measurement techniques and a cooking conversion chart.

   2.2) The healthy menu store consisted of 60 developed menus. Each recipe comprised the ingredients, amounts, pictures, preparation and period, cooking method and period, health benefits, and modification suggestions. The number of servings and dish decorations were suggested. The serving size was suggested as number of household units for each food group contained in the finished dish. Nutritive values of one serving for important nutrients that are particularly related to elderly health were provided (i.e., calories, carbohydrates, fat, protein, dietary fibre, cholesterol, calcium, and sodium). Furthermore, a cooking tutorial clip with Thai subtitles was included in the cooking method section.

   Users could tap on the heart icon to add the menu item to their favourite menu (Figure 4a). They could also edit recipes, upload pictures of the finished dish of their new menu, and change the details of the menu by typing. Users could choose the type and amount of ingredients from the application database and then the nutritive values would automatically be recalculated (Figure 4b). The new healthy recipes created by users were saved as their recipes and not shown on the community board unless they tap on the share button.

3. Healthy community board

    This sharing area aimed to motivate each user to pay more attention to healthy food consumption and have stronger adherence to the application. Users could choose to share their edited menu and vote for others, and then the list of popular menu items would be sorted by the number of users' votes. There are categories for sharing and voting, such as "Super easy recipes", "The best for age", and "Top hit menus" (Figure 4c). Moreover, users could post any question they wanted to ask other users or any topics to share. Other users could independently answer the question or share or post any comments on each topic (Figure 4d).

    The results of the application prototype evaluation suggested that most of the experts marked "very agree" on its content, design, usability, and acceptability. A total of 41 elderly volunteers tested the application prototype for four weeks and completed pre-test and post-test questionnaires on healthy eating practices. The quality of healthy eating practices significantly increased ($p<0.05$, Wilcoxon signed-rank test) from 26.1($\pm$5.5) to 29.3($\pm$4.1) out of 36 points. The quantity of healthy eating practices showed that they ate significantly more rice/starch, vegetables, and meat than at baseline ($p<0.05$), whereas fruits, nuts, milk, water, oil, and sugar consumption did not change, as shown in Table 1.

DISCUSSION

The systematic approach to conducting literature reviews and expert consultations ensured that the development of the nutrition learning tool was grounded in evidence-based practices and informed by the latest research and expert opinions. It facilitated the creation of a tool that was informative, user-friendly, and tailored to the specific needs and contexts of Thai elderly people.

The main content – eating guidelines based on the nutrition flag for Thai elderly people, was applied in the same manner as some scientific, evidence-based developed applications. For example, healthy eating guidelines and nutritional status assessments were
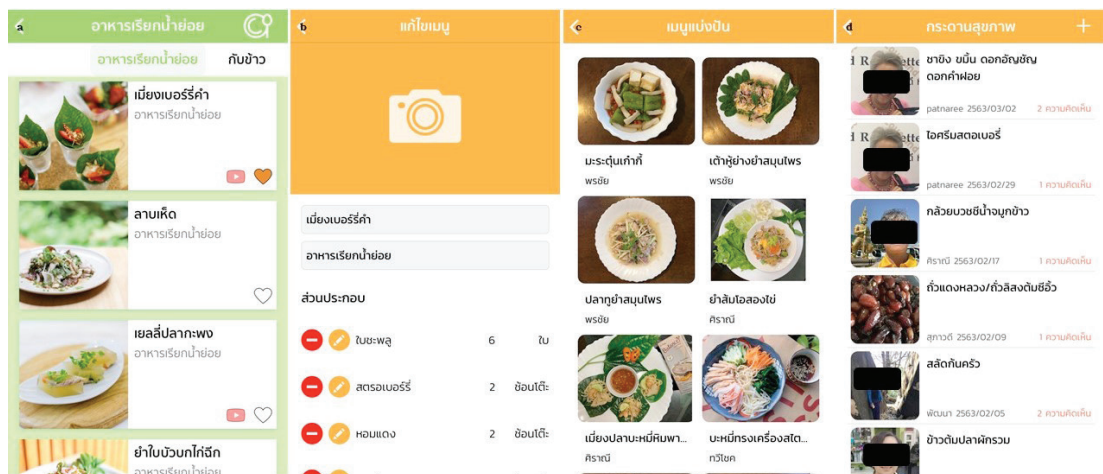

Figure 4 (a-d). Examples of healthy recipes, an edit page, and a healthy community board.

Table 1. Comparison of food consumption among elderly before and after application use

	Recommended intake	Mean±SD		p-value
		Before	After	
Rice-starchy (rice serving spoon)	7-9	4.1±1.5	4.9±1.6	<0.001[β]
Vegetables (rice serving spoon)	4	3.2±1.8	4.2±1.8	<0.001[α]
Fruits (portion)	1-3	2.6±1.3	2.6±1.4	0.955[β]
Meat (tablespoon)	6-8	6.5±1.8	7.4±2.5	0.028[α]
Nut (tablespoon)	1	1.7±1.7	1.5±1.3	0.198[α]
Milk (glass)	1-2	0.7±0.8	0.7±0.7	0.281[α]
Oil (teaspoon)	<6	1.7±0.8	1.5±1.0	0.192[β]
Added sugar (teaspoon)	<6	1.9±1.2	1.6±1.2	0.061[α]
Water (glass)	8	7.6±1.9	7.4±1.5	0.393[β]

[α]p values were obtained from the Wilcoxon signed-rank test
[β]p values were obtained from paired *t*-test

provided in the WE Sihat (Ali *et al.,* 2012). Information on BMI, suggested menus, and caloric intake were provided by Nutrihealth (Salim *et al.,* 2017). Healthy eating guidelines and records of food consumption in the Thai language were provided by Elder Eat (Meephak, Tepbanchaporn & Jarupaibul, 2018). A combination of adherence to the scientific, user requirements gathering, and application to the context of the Thai elderly population resulted in this application prototype corresponding to its objectives.

Graphics and interactive functions were provided to support self-learning, understanding of practical knowledge, and making users feel engaged and interested. All recipes were developed following a healthy diet concept aimed at reducing the risk of NCDs. Most of the ingredients in the suggested healthy recipes were available in local markets and the elderly had easy access to fresh ingredients. There were in-app suggestions on replaceable alternative ingredients if they were not preferred or could not be supplied in the menu. This suggestion could be a healthy choice to support a variety of food preferences and address the complexity of health problems among elderly people. Moreover, when developing recipes and

cooking tutorial clips, particularly for populations, such as the elderly, who may be more susceptible to foodborne illnesses, adherence to food sanitation principles is essential. All suggested healthy menus were approved by Thai elderly people and verified by a chef experienced in creating healthy diets, as well as trained nutritionists to guarantee that they would be a favourite among the Thai elderly with good taste and appropriate nutrients.

An adaptable function was also provided for utilising the interactive functions and complex calculations to enhance the creativity of healthy cooking ideas, which could promote healthy cooking and eating practices among elderly people. Cooking tutorial clips supported elderly people with low culinary skills; they could more easily achieve a healthy diet by watching brief, focused cooking lessons delivered through videos. These clips were designed to teach viewers how to prepare specific dishes by providing step-by-step visual and subtitle instructions.

The healthy community was a sharing area where users could participate, such as sharing their menus and cooking techniques. The vote function could contribute to users' adherence because they felt competitive. Moreover, users

could receive real rewards from partners if this application was further developed at the business level. These factors will strengthen decisiveness about healthy cooking and eating practices among elderly people.

A total of 41 elderly volunteers tested the application prototype for four weeks and the application improved their healthy eating practice, increasing rice/starch, vegetables, and meat consumption. Even though they increased their consumption of rice/starch from 4.1 to 4.9 rice serving spoons ($p<0.001$), they did not meet the suggestion of the eating guidelines for 7-9 rice serving spoons. Fortunately, the participants ate more coloured rice, such as brown rice and riceberry, consumed more complex carbohydrates, and avoided simple carbohydrates. The number of vegetables consumed increased from 3.2 to 4.2 rice serving spoons ($p<0.001$), which met the suggestion of the eating guidelines. Furthermore, they ate various colours and types of vegetables. This was the advantage of the touchscreen presentation on unlimited colourful pictures of ingredients and finished dishes, which can stimulate appetite and result in cooking and eating for elderly people following the suggested recipes in the application. Moreover, they significantly increased meat consumption by one tablespoon ($p<0.05$). The popular meats were fish, eggs, lean chicken, and lean pork. Most of the elderly people avoided processed meat and animal skins. These were the healthy eating practices provided in the application. Unfortunately, no increase was observed in milk consumption among the participants; however, they could derive increased protein levels from increased meat consumption. Other food groups were unchanged, having reached the guidelines at the beginning of the implementation.

This study had many strengths, i.e., the application was developed based on requirements and context-specific information for Thai elderly people; the content and design were approved by experts in related areas; the method was designed to be user-friendly and attractive; and touchscreen device functions such as interactivity, complex calculations, taking photos, and accessing the internet were utilised. Zooming figures and graphics instead of descriptions helped elderly people understand important information and feel comfortable using it. Moreover, the application can always improve its performance and update information. However, there were also some limitations; for example, this kind of learning tool can be difficult to access among people of lower socio-demographics and may be replaced by new technology.

CONCLUSION

The nutrition learning tool development process, which was based on scientific literature, expert consultation, and user requirements, contributed content and design corresponding to the objectives. The utilisation of touchscreen devices such as interactive devices, complex calculations, photos, and access to the internet resulted in the application being attractive, interesting, and suitable for elderly use.

This application prototype, namely "YoungYou", could be an alternative tool for promoting healthy eating among Thai elderly people based on three main aspects: 1) health and nutrition information related to elderly people; 2) a healthy diet; and 3) a healthy community board. The evaluation of content, design, usability, and acceptability by three experts in the nutrition area, education area, and area of media and communications agreed strongly with

each other. When tested for four weeks on 41 elderly volunteers, the prototype was found to be effective at increasing both quality and quantity of healthy eating practices.

This application prototype could be further developed at the business level; for example, food businesses could tie in their products to the suggested menu for a sales boost. This approach could also be developed for other operating systems in the future. Furthermore, this study could be a future research direction for further studies on nutrition promotion, especially for elderly people, which could lead to future policies for elderly people's health promotion aimed at improving their quality of life and well-being.

Authors' contributions
Padawech N, led the application development, conducted the study, data collection, data analysis and interpretation, prepared the draft of the manuscript and reviewed the manuscript; Luangjinda C, advised on the conceptualisation and design of the application, reviewed the manuscript; Tantixalerm C, advised on the design of the application and learning process by the elderly, reviewed the manuscript; Hudthagosol C, principal investigator, advised on the conceptualisation of the study, led the application development, data collection, analysis and interpretation, reviewed the manuscript.

Conflict of Interest
The authors declare that they have no conflicts of interest regarding this study.

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