ORIGINAL ARTICLE

Usability Evaluation of Web-based Dietary Application MyProteinGuide™ among Caregivers of Children with Disorders of Amino Acid Metabolism (AAMDs)

Lim Jing Ying[1,2], Roslee Rajikan[1], Mohamad Nazlena Ali[3], Noh Amit[5], Haslina Abdul Hamid[4], Leong Huey Yin[6], Maslina Mohamad[7], Koh Bi Qi[7]

[1] Dietetics Program & Centre of Healthy Aging and Wellness (H-Care), Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300 Kuala Lumpur, Wilayah Persekutuan Kuala Lumpur, Malaysia
[2] Dietetics Department, Faculty of Medicines and Health Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia
[3] Institute of IR4.0 (IIR4.0), Akademia Siber Teknopolis, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia
[4] Dietetics Program & Center for Community Health Studies (ReaCH), Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300 Kuala Lumpur, Wilayah Persekutuan Kuala Lumpur, Malaysia
[5] Clinical Psychology and Behavioural Health Program & Center for Community Health Studies (ReaCH), Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300 Kuala Lumpur, Wilayah Persekutuan Kuala Lumpur, Malaysia
[6] Genetics Department, Hospital Kuala Lumpur, Jalan Pahang, 50586 Kuala Lumpur, Wilayah Persekutuan Kuala Lumpur, Malaysia
[7] Dietetics & Food Service Department, Hospital Kuala Lumpur, Jalan Pahang, 50586 Kuala Lumpur, Wilayah Persekutuan Kuala Lumpur, Malaysia

ABSTRACT

Introduction: Dietary intervention is the cornerstone in the management of disorders of amino acid metabolism (AAMDs). Therefore, a MyProteinGuide™ web-based application was developed to assist the caregivers of AAMDs in self-monitoring their nutritional status especially the dietary intake. **Materials and methods:** A cross-sectional study was conducted to evaluate the usability of the MyProteinGuide™ web-based application among caregivers of patients diagnosed with AAMDs including aminoacidopathies (AA), Organic Aciduria (OA) and Urea Cycle Disorders (UCD) aged between 6 months to 18-year-old who are receiving treatment in the genetic clinic, *Hospital Kuala Lumpur (HKL)* and *Hospital Pulau Pinang (HPP)*. A total of 30 caregivers participated in this study, out of most of the caregivers had children with AA (43.3%), followed by OA (30.0%) and UCD (26.7%). The Malay version of mHealth application usability questionnaire (MAUQ) and System Usability Scale (SUS) were used as the assessment tools to assess the application usability. **Results:** An overall usability mean (SD) score of 5.88 (0.76) out of a maximum score of seven as rated by MAUQ while SUS score was 78.17 (15.70), indicating good usability. In term of domain breakdown, the highest scoring domain being Domain 3: Usefulness 5.99 (0.79) followed by Domain 2: User Interface and Satisfaction 5.94 (0.73) and Domain 1: Ease of Use 5.69 (0.91). Suggestions to improve the application include to make it into a responsive web application or mobile application which are user-friendly to both mobile phone user. **Conclusion:** In conclusion, the usability results showed that MyProteinGuide™ had a good usability.
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Keywords: Usability, Web-based intervention, Caregivers, Amino acid metabolism disorders, Inborn

Corresponding Author:
Roslee Rajikan, PhD
Email: roslee@ukm.edu.my
Tel : +603-8921 3856

INTRODUCTION

Disorders of amino acid metabolism (AAMDs) are a heterogeneous group of disorders caused by a different single enzyme deficiency, resulting in the accumulation of toxic metabolites (1). These disorders necessitate a life-long restrictive diet with the goal of achieving optimum nutritional status whilst enabling metabolic control (2). Nutritional strategies included a restricted natural protein intake, supplementation of metabolic formula and provision of special low protein food in the daily diet (3). Without sustainable dietary intervention, toxic metabolites will accumulate and lead to clinical symptoms such as lethargy, reduced appetite and vomiting to severe neurological impairment such as seizure, coma, muscle hypertonia and hypotonia (4). Despite the importance of dietary treatment, adherence to dietary treatment can present a number of challenges including tedious food preparation, limited knowledge

regarding food preparation as well as limited food choices (5). As such, an alternative method in assisting self-monitoring and delivery dietary education to the caregivers is needed to ensure dietary compliance among patients with AAMDs.

The use of digital health interventions (DHI) has been proven to have a significant influence on reinforcing and contributing positive nutritional outcomes such as improvement in anthropometric measurements among patients with chronic diseases by assisting them in their coping and self-management, both medical and psychological (6,7). In addition to that, previous studies also revealed that DHI promoted self-monitoring among app users compared to users of a paper journal (8,9). As such, DHI is not limited to assist individuals with certain chronic medical conditions such as diabetes, cancer, and coronary artery disease but also to be attuned to the needs of individuals with metabolic disorders in which self-monitoring of dietary natural protein intake is vital for them to achieve optimal metabolic control (10).

Traditionally, patients' caregivers were asked to monitor their diet by keeping a food diary using the traditional paper method. However, this self-monitoring approach may be viewed as burdensome, leading to decreased self-monitoring frequency and compromised metabolic control. Diet tracking mobile application assists the caregivers in auto-calculating the energy and macronutrients of every food item entered and comparing against set requirements determined by the dietitian, hence increasing the frequency of self-monitoring (11,12). Therefore, a carefully designed digital health intervention has the potential to assist in self-monitoring and disseminate nutrition education hence improving the adherence.

MyProteinGuide™ is a web-based application which comprises of mostly all the nutritional assessment components including client history, anthropometry, biochemical data and dietary intake monitoring as outlined in the nutritional care process aiming to assist the healthcare professionals in monitoring the nutritional status of the patients as well as to empower the self-monitoring process among the caregivers. It also consists of educational materials such as diseases information, food composition database and low protein recipes (unpublished data). Besides that, this application was validated by groups of clinical geneticists and dietitians experienced in inherited metabolic disorders and the content validation was reported as 0.983 in which the module was deemed validated for content (unpublished data).

Evaluation of an application is essential to judge whether or not an intervention achieves its desired effect and according to the IDEAS (Integrate, Design, Assess, and Share) framework, the assessment of usability is one of the methods to evaluate the application (13). Designing a system and measuring its usability is an important component in the development of digital applications to ensure that health technologies are appropriately designed and targeted to the end-users' needs before they are used as health interventions (14 - 17). This evaluation plays a crucial role in ensuring the systems either a software, a web site or any information and communication technology or service are adapted to the users, their tasks and that there are no negative outcomes of their usage (18). Nevertheless, it has been reported that about 95% of the available role technology interventions have not been evaluated in terms of usability (17). A well-designed and highly usable app positively affect user engagement while poor usability is related to dissatisfied users, decreased effectiveness, and increases in error costs (19). Therefore, this study aims to evaluate the usability of a web-based application MyProteinGuide™ among the caregivers of patients with AAMDs.

MATERIALS AND METHODS

Study Design and Sample Selection

A cross-sectional study was conducted among the caregivers of patients diagnosed with disorders of amino acid metabolism (AAMDs). Caregivers of patients diagnosed with AAMDs which include aminoacidopathies (AA), Organic Aciduria (OA) and Urea Cycle Disorders (UCD) aged between 6 months to 18-year-old who are currently receiving active both medical and dietary treatment in the genetic clinic, *Hospital Kuala Lumpur (HKL)* and *Hospital Pulau Pinang (HPP)* were recruited as participants. In view of this is a continuous study from previous studies (5,20), patients who had transferred from HKL to HPP for continuous of care were also included. In addition to that, the caregivers must be aged 18-year-old and above and own any technological devices such as laptop, personal computer, tablet or smartphone with internet connectivity. Caregivers who are unable to write and communicate in Malay or English were excluded. Lastly, patients on tube feeding or gastrotomy completely were also excluded. Ethical approved was obtained from the Medical Research Ethics Committee (MREC) via the National Medical Research Register of the Ministry of Health Malaysia (NMRR-21-1845-6108, 3 November, 2021)" and the Secretariat of Research Ethics Committee, Univerisiti Kebangsaan Malaysia (JEPUKM-2021-765), 18 November 2021.

Sample Size and Sampling Method

According to Faulkner (21), conducting usability testing with only 30 participants will reveal 99% of usability problems. Since this is a study aiming to assess the usability of the MyProteinGuide™ among caregivers, 30 participants will be sufficient to estimate the parameters measured. Purposive sampling was used in this study to achieve a sample of caregivers of children which can fulfill the criteria of this study as inherited metabolic

disorders are a heterogeneous group of disorders (22).

Data Collection Procedures

Subsamples of participants (n=30) from the needs assessment study were recruited voluntarily to take part in the study (20). The caregivers were recruited from the list of patients receiving treatment at the genetic clinic in HKL through phone call. The contact number of the caregivers were obtained from the metabolic dietitian who kept a personal information of the patients. All the caregivers being approach were given a detailed explanation about the purpose of the study, the procedures of data collection as well as the voluntary nature of participation. In view of the nature of rare disease, we were unable to gather all the caregivers at a same place and time to do the demonstration as most of the caregivers are staying outside Selangor. Hence, the caregivers were approached in a hybrid method as face-to face demonstration of the application cannot be done to everyone.

Demonstration of the application, mainly focusing on its development, special features and key functionality specifications were conducted face-to-face to the caregivers who attended the appointment in the genetic clinic. At the same time, for the participants who did not attend the appointment, the self-enrolment process was demonstrated by the student researcher via online conferencing software, which is the Google Meet or Zoom. For some of the caregivers who were unable to attend the demonstration session but interested to participate, a recording of the demonstration video was sent to them for them to follow the tutorial to provide flexibility to the caregivers to listen to the recordings at their own pace. Prior to the demonstration, the participants were given a step-by-step tutorial and task scenarios in a PDF document for using the MyProteinGuide™ application in order to ensure that all functionalities of the web-based application were used. There were asked to explore the application for 5-10 minutes. Any doubts raised by the participant were answered by the researchers. Once completed, participants were provided with a Google Form link to answer the Malay mHealth application usability (M-MAUQ) (23) and *Skala Kebolehgunaan Aplikasi Mudah Alih (SKAMA)*, the Malay language variant of the System Usability Scale (SUS) questionnaire (24) regarding the usability aspect of the MyProteinGuide™ application along with two additional questions requesting their feedback and experiences while using the application. The questionnaire was administered in bilanguage for the participants to choose their preferred language to facilitate the process. The participants were contacted by telephone call to remind them to answer the survey and the link was given through WhatsApp.

Malay mHealth Application Usability Questionnaire (M-MAUQ)

The mHealth application usability Questionnaire (MAUQ) was developed and validated to assess the usability of mHealth apps among patients and healthcare providers (25). There are four different versions of MAUQ which are designed for different users (patients or health care providers) and different interaction modes (interactive or standalone). The M-MAUQ used in this study is the translated version of the standalone patient version in the Malay language (23). The questionnaire consists of 18 items which are divided into 3 subscales: ease of use (5 items), interface and satisfaction (7 items), and usefulness (6 items). 7-point likert scale ranging from 1 (strongly disagree) to 7 (strongly agree) was used to determine the usability of the application by the caregivers. However, only 17 questions were included in this study as the question related to the usage of the application in the absence of WiFi is not applicable in this study. The usability was determined by the total and average of all statements. A higher overall score indicates a better usability. The usability of the application is considered as good if the average score is higher than 4.

Skala Kebolehgunaan Aplikasi Mudah Alih (SKAMA)

SKAMA is the translated Malay version of the System Usability Scale (SUS) questionnaire. The SUS questionnaire was developed in 1986 and was a simple, quick, and cost-effective method to assess the usability of a system or product (26). The SKAMA questionnaire was readily translated, cross-culturally adapted and validated with content and face validity scored above 0.83 indicating all items in the questionnaire are relevant to the domain, clear, and comprehensible for the target users (24). It consisted of a 10-item survey rated from 1 (strongly disagree) to 5 (strongly agree) on a 5-point Likert scale. The usability measurement included in SUS covered the effectiveness, efficiency and user satisfaction. The positive and negative statements in the questionnaires were arranged alternatively in order to minimize habitual bias on the part of the respondent. A response is classified as positive if a score of 5 or 4 was given for odd items (positive statements) and a score of 1 or 2 was given for even items (negative statements); a score of 3 was rated as neutral (27). The contribution of the score to the even items was 5 minus the scale position and the contribution to the odd items was the scale position minus 1. The total SUS score was calculated by multiplying the sum of the scores by 2.5 out of the total number of items giving a total score of 100. A score of 68 and above for a system or product reflects good usability.

RESULTS

Sociodemographic Characteristics of Caregivers of AAMDs

A total of 30 caregivers of patients with AAMDs took part in the usability testing of the MyProteinGuide™. Table I describes the caregivers' socio-demographic characteristics. Out of 30 caregivers, most of the caregivers had children with AA (43.3%), followed

by OA (30.0%) and UCD (26.7%). Majority of the participants were female (93.3%), Malay (85.5%) and working (63.3%), aged 40-49 years old (46.7%) and possessed at least a diploma (60.0%).

Table I: Socio-demographic characteristics of the caregivers (n = 30)

Characteristics (N=30)	n (%)
Types of AAMDs of children	
Aminoacidopathies	13 (43.3%)
Urea cycle disorders	8 (26.7%)
Organic Acidurias	9 (30.0%)
Sex	
Male	2 (6.7%)
Female	28 (93.3%)
Age of caregiver	
20-29	2 (6.7%)
30-39	13 (43.3%)
40-49	14 (46.7%)
≥50	1 (3.3%)
Races	
Malay	25 (85.5%)
Chinese	4 (13.3%)
Indian	1 (3.3%)
Educational level	
Secondary school	12 (40.0%)
Diploma/Degree/PhD	18 (60.0%)
Employment	
Currently working	19 (63.3%)
Housewife/Not working/Retirees	11 (36.7%)
Household Income	
B40 (<RM 4851)	18 (60.0%)
M40 (RM 4851-10959)	7 (17.1%)
T20 (≥RM 10960)	5 (13.2%)

Usability of MyProteinGuide™ using System Usability Scale (SUS)

Usability testing of MyProteinGuide™ was performed in May and June 2023. A total of 40 participants were approached, however only 30 caregivers completed the tasks given and submitted the questionnaire at the end of the study. The results were shown in Table II.

Table II: MyProteinGuide™ usability using Sistem Usability Scale (SUS)

Statements	Positive responses n (%)	Neutral responses n (%)	Negative responses n (%)
I think that I would like to use MyProteinGuide™ frequently.	22 (73.3%)	8 (26.7%)	0
I found MyProteinGuide™ unnecessarily complex.	24 (80.0%)	6 (20.0%)	0
I thought MyProteinGuide™ was easy to use.	23 (76.7%)	7 (23.3%)	0
I think that I would need the support of a technical person to be able to use MyProteinGuide™.	22 (73.3%)	8 (26.7%)	0
I found the various functions in MyProteinGuide™ were well integrated.	26 (86.7%)	3 (10.0%)	1 (3.3%)
I thought there was too much inconsistency in MyProteinGuide™	24 (80.0%)	5 (16.7%)	0
I would imagine that most people would learn to use MyProteinGuide™ very quickly.	22 (73.3%)	8 (26.7%)	0
I found the MyProteinGuide™ very cumbersome to use.	23 (76.7%)	6 (20.0%)	1 (3.3%)
I felt very confident using the MyProteinGuide™.	25 (83.3%)	3 (10.0%)	2 (6.7%)
I needed to learn a lot of things before I could get going with MyProteinGuide™.	18 (60.0%)	5 (16.7%)	7 (23.3%)
Mean SUS Scores	78.17 (15.70)		

For all questions, the proportion of positive responses was higher than that of negative and neutral responses. The question with the most favourable answer (86.7% positive) was whether the various functions were well integrated, followed by whether they were confident using the MyProteinGuide™ (83.3%). The question with the least favourable responses was about the need to learn a lot of things before launching the MyProteinGuide™ application (23.3% negative). The mean (SD) usability score of MyProteinGuide™ was 77.0 (14.18), higher than the minimum score for usable system which was 68, indicating good usability.

Usability of MyProteinGuide™ using Malay mHealth Application Usability Questionnaire (M-MAUQ)

Table III describes the breakdown of the M-MAUQ scores by domain and of each statement. An overall usability score of 5.88 (0.76) out of a maximum score of seven was reported indicating good usability. The highest scoring domain being Domain 3: Usefulness 5.99 (0.79) followed by Domain 2: User Interface and Satisfaction 5.94 (0.73) and lastly Domain 1: Ease of Use 5.69 (0.91). The 14th statement, 'MyProteinGuide™ improved my access to health care services.' scored the highest at 6.27 (0.69) while the 4h statement, 'The navigation was consistent when moving between screens" scored the lowest at 5.50 (1.07).

Table III: Usability of MyProteinGuide™ using Malay mHealth Application Usability Questionnaire (M-MAUQ)

MAUQ Statements (English version)	Mean Scores (SD)
Overall	5.88 (0.76)
Domain 1: Ease of Use	5.69 (0.91)
MyProteinGuide™ was easy to use.	5.77 (1.07)
It was easy for me to learn to use MyProteinGuide™.	5.90 (1.03)
The navigation was consistent when moving between screens.	5.50 (1.07)

CONTINUE

CONTINUE

Table III: Usability of MyProteinGuide™ using Malay mHealth Application Usability Questionnaire (M-MAUQ). (CONT.)

MAUQ Statements (English version)	Mean Scores (SD)
The interface of the MyProteinGuide™ allowed me to use all the functions (such as entering information, responding to reminders, viewing information) offered by the app.	5.77 (1.36)
Whenever I made a mistake using MyProteinGuide™, I could recover easily and quickly.	5.53 (1.36)
Domain 2: User Interface and Satisfaction	5.94 (0.73)
I like the interface of the MyProteinGuide™.	5.80 (1.00)
The information in the MyProteinGuide™ was well organized, so I could easily find the information I needed.	6.00 (0.91)
MyProteinGuide™ adequately acknowledged and provided information to let me know the progress of my action.	5.77 (0.94)
I feel comfortable using MyProteinGuide™ in social settings.	6.03 (0.67)
The amount of time involved in using MyProteinGuide™ has been fitting for me.	5.87 (0.90)
I would use MyProteinGuide™ again.	6.00 (1.02)
Overall, I am satisfied with MyProteinGuide™.	6.13 (0.97)
Domain 3: Usefulness	5.99 (0.79)
MyProteinGuide™ would be useful for my health and well-being.	6.00 (0.95)
MyProteinGuide™ improved my access to health care services.	6.27 (0.69)
MyProteinGuide™ helped me manage my health effectively.	6.07 (0.78)
MyProteinGuide™ has all the functions and capabilities I expected it to have.	5.73 (1.14)
MyProteinGuide™ provided an acceptable way to receive health care services, such as accessing educational materials, tracking my own activities, and performing self-assessment.	5.90 (0.96)

Some of the positive responses received from the caregivers was the use of the application can ease the process of monitoring and calculating total protein intake daily as well as the inclusion of the plasma amino acids monitoring in the application can be used as a reference for the caregivers to compare the past and present results when their children was admitted to ward. Besides that, feedbacks regarding the interfaces and designs were also received. Caregivers mentioned that the pictures are very clear and easy to navigate.

The key issues and suggestions from the usability testing are reported in Table IV. The main issues identified by the users were the MyProteinGuide™ was not user-friendly to mobile-phone users as the web design is not automatically adjust for different screen sizes (HTML responsive) and limited food items in the database. Besides that, the total amount of protein intake cannot be viewed clearly for the past few days and months. Likewise, the main suggestion was to make the MyProteinGuide™ into a mobile application or a web application which is user-friendly to all the users either using laptop or mobile phone. In addition to that, it was also suggested that users should be able to enter food items which are not available in the application manually. Lastly, caregivers also suggested the total natural protein and calories intake should be generated in a graph monthly alongside with the biochemical data.

Table IV: The issues and suggestions

Key Issues	Suggestions
Not user-friendly to mobile-phone users as the web design is not automatically adjust for different screen sizes	Upgrade MyProteinGuide™ into a mobile application or a responsive web design which is user-friendly to all the users either using laptop or mobile phone
Limited food items in the database	Expand the available choices in the food database
Unable to key in the food items manually	A function 'add your own foods' should be included to accommodate new foods not included in the application
Total amount of protein intake cannot be viewed clearly for the past few days and months	Generate total natural protein and calories intake in a graph monthly alongside with the biochemical data.

DISCUSSION

In this study, we evaluated the usability of this web-based application MyProteinGuide™ using two questionnaires which are the System Usability Scale (SUS) and mHealth App Usability Questionnaire (MAUQ). Two different questionnaires were used in this study instead of only one questionnaire which was reported in previous studies (28,29), as SUS is a versatile tool widely used in the assessment of perceived usability in standard task-based usability testing such as desktop systems (30) but not specifically designed for mobile health (mHealth) apps. Hence, some of the elements related to the unique features offered by an individual health information technology system will not be able to be assessed using the SUS questionnaire only (25). Since MyProteinGuide™ is a desktop system instead of a mHealth apps, SUS served as a complementary tool to MAUQ in assessing the usability part of a desktop-based application. In terms of MyProteinGuide™ usability testing, this study had found that all of the respondents highly regarded that the MyProteinGuide™ application is usable, with a SUS score of 77.0 (14.18) and MAUQ score of 5.88 (0.76). Our study revealed that the objective measurement to determine the usability of the MyProteinGuide™ application was in line with the qualitative comments from the caregivers in which the third domain (usefulness) scoring the highest among the three domains. This finding was consistent with previous studies (28, 31) indicating that the application serves its intended purpose of easing the process of calculating natural protein intake and monitoring the metabolic

control which was also reported by the caregivers in the open-ended questions. The inclusion of open-ended questions at the end of the SUS can help to further define strengths and problems associated with the web-based applications (27).

Nevertheless, differed with previous studies (29, 32, 33). our study revealed that "ease of use" scored lowest among the three domains. A possible explanation for scoring the lowest for "ease of use" in this study might be the web-based design of the application which is not user-friendly to the mobile phone user. This dissatisfaction may be explained by the fact that a responsive web design is not adopted in designing the web application in this web-based application. Responsive web design is the approach that suggests that design and development should respond to the user's behaviour and environment based on screen size, platform and orientation with regards to devices (34). Since the web design of the application is not responsive, the website is unable to automatically switch to accommodate different resolutions, image sizes and scripting abilities when the users switch from a desktop view to mobile view since the resolution had been set at a desktop view. Nevertheless, it must be noted that this is our initial version of application, hence the desktop development was always the primary focus and implementation of the responsive design often occurs only in the final stages as it requires extensive user time and effort. (35). Furthermore, it has been suggested that desktop-first development enables more complex, creative, or impressive designs. (35). In our study, since some of the participants were using mobile phone to assess the web-application, they were asked to request a desktop view in their own browsers to load the site in full desktop view without compromising the screen size (36). In addition to that, it had also been reported in the qualitative comment as most of the caregivers wish to have MyProteinGuide™ as a mobile application for the ease of their use. However, initially the research team decided to develop MyProteinGuide™ in the form of web-based application for the ease of dissemination. A web-based application can be accessible immediately without having to download and install it, shared rapidly among friends, and viewed on a computer, hence able to reach a wider audience compared to a mobile application. (37).

Similar to previous study (27), SUS scores showed that the most significant usability issue with MyProteinGuide™ was the need to learn a lot of things before exploring the web-based application as perceived by nearly a quarter of the caregivers. This might be due the registration process of the application which requires the caregivers to enter their personal details regarding their health information before allowing them to explore the other features of the MyProteinGuide™. One of the information needed to fill in is the types of amino acid disorders. However, only abbreviation of the name of the disorders such as UCD, MMA are listed for the caregivers to choose from. In our study, some of the caregivers demonstrated limited understanding towards the abbreviation of the disorders, hence they have to check with the dietitian in the research team, possibly leading to the perception that they need to learn more things before using the application (38). At the same time, the caregivers of children with urea cycle disorders (UCD) are usually introduced to the names related to the enzyme deficiencies, hence some of them are not familiar with the name UCD, which causes some confusion. As such, it was suggested in the future, the details of the full name of the disorders might be listed down in the application as tooltips. Besides that, although we had provided the user manual to the caregivers in this study, some of them chose to experiment with the application a few times before reading the user manual to understand the functionality of the application (32).

Some of the issues identified from the qualitative comments included the limited food database. Although our research team had improvised the variety of food compared to the nutritional booklet as per requested during the needs assessment, there were still lacking of food which might due to a wide range of low protein cereal-based commercial products consumed. As a result, as suggested by the caregivers, a recipe builder will be incorporated in the future to enable users to log their own food items that are not available in the database under the guidance of a dietitian to avoid error in entering the nutritional information (28).

To the best of author's knowledge, this is the first study to evaluate the usability of a web-based application among the caregivers of patients with AAMDs in Malaysia context. However, there were some limitations to the current study. Firstly, this is a cross-sectional study in which the interval between the use of the application and its evaluation was insufficient for the participants to reveal more usability issues as well as to measure the efficiency of the application in assisting them to manage their health conditions and overall well-being impacts over a longer time span (29). In addition to that, this study only employed one type of method to evaluate the usability of the application. The results from questionnaire provide an overall measure of usability but do not pinpoint the problems that need to be addressed (39). Although additional open-ended questions were included in the survey for the caregivers to list down their qualitative comments, some of the caregivers might choose not to write down due to their time constraints and limited vocabulary to describe their thoughts. Hence, it was suggested that future study involving usability evaluation should use a multifaceted approach involving qualitative methods such as the "Think-Aloud" protocol, interviews, and focus groups discussion to gather a rich amount of data and enabled

data triangulation (39, 40).

CONCLUSION

The result concludes that MyProteinGuide™ showed encouraging findings of its ease of use, interface and satisfaction, and usefulness. Nevertheless, the usability assessment indicated that a few usability issues of the MyProteinGuide™ application need to be improved. The organization of the interfaces, variety of food items in the food database, and the functionality of the applications such as the allowance to add new food items need to be improved according to the recommendations. The present study will serve as a base for future studies in improving the interface and system of MyProteinGuide™ such as developing a mobile application or a web-based application with responsive web design to promote usage among the caregivers. The study also fulfils the main objective of evaluating the usability behind a web-based application.

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