Effectiveness of Using Android-Based Applications for Nutrition Monitoring of Toddlers in Banda Aceh

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Abstract

BACKGROUND: The nutritional situation for toddler in Indonesia is based on the Riskesdas data report that Indonesia still has problems with underweight, stunting, and wasting. Fulfillment of nutritional status information on an individual basis can be fulfilled using the online application system. Problem the quality of data on nutritional status and the process of management that is still being carried out conventionally. It is necessary to design an application that is user-friendly for nutrition workers to monitor the nutritional status and growth and development of children under five in Aceh.

AIM: Analyzing the Effectiveness of Using Android Smartphone-Based Applications for Monitoring Nutrition for Toddlers in the city of Banda Aceh.

METHODS: This study uses a Research and Development design. This research has been conducted in the Banda Aceh City Region, considering that data on malnutrition is still high, data are available underweight, wasting, and stunting. Primary and secondary data were conducted by interview and observation using a questionnaire training using the Android-based PSG toddler application tool. The research stages were carried out by collect data and proceed with system design using the method prototyping. The validity of the data in this study was carried out using triangulation techniques. Data in the form of words will be processed into meaningful sentences so that information is obtained required. The data analysis phase consisted of data reduction and presentation data (data display) and concluding (conclusion: Drawing/verifying).

RESULTS: The results showed that the PSG toddler application had a positive impact and significantly affected the quality of nutrition data, especially nutritional status data toddlers. The Android-based PSG toddler application has a good quality value compared with the use of a nutritional status monitoring book (PSG conventionally). An electronic-based system (PSG toddler application based on android) is of higher quality sound. The output of data analysis is more, both for monitoring and evaluation planning nutrition program and supporting decision-making in handling problems nutritional problems in Banda Aceh. The research results also show an Android-based application, particularly the PSG toddler application, as user-friendliness and are more user-friendly. Application following other nutritional status monitoring programs in calculating nutritional status, PSG Toddlers must cover four indexes: BB/U index, TB/U index, index BB/TB, and index body mass index/U.

CONCLUSION: The use of the Android-based Toddler Nutrition Monitoring Application is effective in monitoring the growth and development of toddler nutrition in Aceh.

Introduction

Maternal and child malnutrition causes more than 10% of the total global disease burden and more than one-third of child deaths [1], [2]. The poor nutritional status of children and mothers has long-term health consequences, and the consequences extend to low intergenerational productivity and continued poverty [3], [4]. Malnutrition also hinders local economic growth, which affects the global economy [5]. Indonesia already has nutritional status monitoring which is an essential reference in food consumption for the population, including those aged 6–24 months. However, its implementation is still limited; one of the factors that cause difficulty in implementation is the limited educational and information communication media, the lack of socialization, and PGS's mobilization in the community [6].

The conceptual framework for handling the problem of growth and development disorders in children developed by the WHO shows that growth and development disorders in children under five are influenced by direct causes, namely, family and household factors, insufficient complementary feeding, and inappropriate breastfeeding practices, and disease infection. While factors caused by social and community factors include; political and economic conditions, health services, education, socio-culture, food and agriculture systems and water, sanitation, and environmental conditions [7]. The nutritional situation of children under five in Indonesia, based on the Riskesdas data report that Indonesia in 2018 still has problems with underweight, stunting, and wasting.

This study showed that the prevalence of underweight children was 17.7%, consisting of 5.7% malnutrition, and 13.9% malnutrition. Likewise, with the prevalence of stunting, nationally in 2018, it was 30.8%.

Furthermore, under five with wasting, Indonesia in 2018 has a prevalence of 10.2% [8]. Even though there has been a decrease in the prevalence of nutritional problems from 2013, this figure is not yet significant [9]. The nutritional status of children under five in Aceh Province, based on 2018 Riskesdas data, shows that the condition has not improved, namely, the high number of cases of acute, chronic nutrition in children under five in particular. There were 23.5% of children under five who had malnutrition and malnutrition (underweight) and 11.9% of thinness or wasting. Furthermore, stunting prevalence is still very high, reaching 37.3%, and is in the third rank after West Sulawesi (41.8%) and NTT (42.6%). While the prevalence in children under 2 years, Aceh has the highest prevalence, which is 18.9%, and the same thing happened in 2013 (19.0%) [10]. The World Health Organization (WHO), in collaboration with several research institutions around the world, is developing new standards for child growth [11].

The development of data and health information systems in cities/districts supports management decision-making, both in improving services and health programs directly [12]. Recording and reporting are indicators of the success of an activity. Recording and reporting are valuable and valuable data and information when using appropriate and correct methods [13]. In monitoring nutritional status, one of the activities is to carry out a weighing and recording process to collect anthropometric data at toddlers starting at the village level (Posyandu), which are then sent to the Public health center. At the Public health center level, the data are processed for decision making in planning, monitoring and controlling, and assessing nutrition programs. The process of community nutrition information system, known as PSG, starts from data collection in the field then processing using information technology so that the data produces good information.

Problems with the quality of nutritional status data and management process that have been carried out conventionally. It is necessary to design a user-friendly application for nutrition workers in monitoring nutritional status and growth and development of children under five in Aceh. Early detection of problems related to toddler malnutrition at the health center level, a preventive treatment model can be immediately carried out in both specific and sensitive interventions to create optimal nutrition. Therefore, it is deemed necessary to conduct an empirical study on the Design and Implementation of 2005 WHO growth standard application based on an android smartphone.

Methods

This study used a Research and Development (R and D) design. This research method is used to produce products and tests their effectiveness. R and D aim to develop a new product or improve an existing product that can be accounted for. This research was conducted in the Banda Aceh City Region; considering that malnutrition data are still high, there are data on underweight, wasting, and stunting. The time of the research was started from June to October.

The involvement of participants in this study was two nutrition workers (nutrition coordinator) at the Banda Aceh City Health Office and two each who served as Nutrition Implementers (TPG) at the Public health center in the city of Banda Aceh (there are 11 Public health center). Based on these provisions, the number of subjects in this study was 24 nutrition workers in all health offices in Banda Aceh. The stages of the research to be carried out are referring to the R and D method using the Waterfall model approach, which is divided into several stages, namely problem identification, field data search, system design, system development, system testing, and report writing.

The research stage was carried out by collecting data and continued with system design using the prototyping method. Model Prototyping is a software development method made by approaching design, function, and user interface. Data in the form of words will be processed into meaningful sentences to obtain the necessary information. The data validity stage in this study was carried out by using triangulation techniques. The analysis to be carried out consists of the data reduction stage, data display, and conclusion: Drawing/verifying.

Results

The study was conducted at 11 health centers within the Banda Aceh City Health Office. All public health centers were included in the analysis unit, and as many as 22 subjects and two subjects were taken from the public health Office. According to research groups, the characteristics of research subjects are presented in Table 1 — characteristics of research subjects that include aspects of age, gender, education, and training.

Characteristics of respondents, in general, are aged 35–50 years (62.5%) and female (79.2%). Meanwhile, based on their educational background, they generally had a D-IV education in nutrition, or the relevant health sector, namely, 41.7% and 83.3% of respondents in this study had attended training related to nutrition. Identification of data needs in the nutritional status monitoring application (PSG Toddler).

Table 1: The distribution of the characteristics of the research subjects according to the research group

Subject Characteristics	Frequency	
	n	%
Age		
25–34 years	9	37.5
35–50 years	15	62.5
Sex		
Male	5	20,8
Female	19	79.2
Education		
D-III Gizi/Medicine	7	29.2
D-IV Gizi/Medicine	10	41,7
S-1 Gizi/Medicine	5	20.8
S-2 Gizi/Medicine	2	8.3
Natricious Training		
Yes	20	83.3
No	4	16.7
Total	24	100.0

The problem that has been discussed and carried out in the preparation of this research is in the form of making a mobile application with an Android operating system, namely, the Mobile application for Calculating Underweight Nutrition Status for 5 years which is then shortened to monitoring the nutritional status (PSG) of toddlers based on Android. The implementation of Nutritional Status Monitoring (PSG) periodically and continuously every year is part of the monitoring and evaluating nutrition improvement activities. Data and information generated from PSG activities can be used as material for decision making and planning for nutrition development activities in an area, particularly in Banda Aceh.
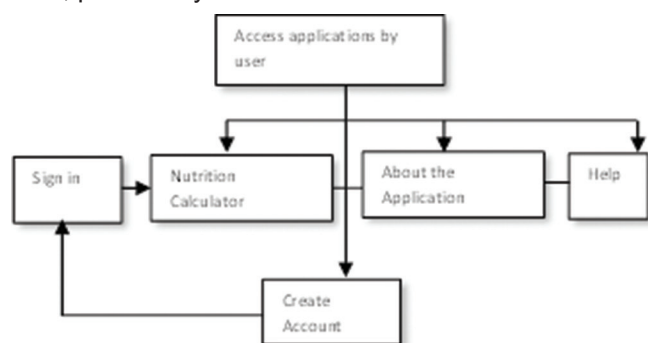

Figure 1: Visitor page menu structure

The stages of determining data need in processing nutritional status data for toddlers on the ease of access and use by nutrition workers at the Puskesmas (TPG) that no Android-based application has been used to carry out an analysis of monitoring the nutritional status of toddlers, some applications that have been developed tend to be used for conduct an individual nutritional status assessment.

To manage data and information on PSG results correctly, the Directorate of Nutrition has developed a Data Entry Application for monitoring nutritional status (PSG. Compared to the WHO Anthro application, when used in exporting the database, it is relatively tricky because exported data must be converted to.dbf or.csv. According to the nutrition staff at the Public health center (TPG), it is difficult for the Nutrition Implementers (TPG) at the Public health center to easily use office applications, namely, Microsoft Excel in data entry and PSG data analysis.

"Currently, we have used the WHO Anthro application, which has been trained, but it is difficult for us to do our daily work. The WHO Anthro cannot provide more detailed data, such as data on the number of children by sex, how many children are malnourished, the number of stunted children, and other data information. We hope that this PSG application can provide statistical results such as the number of children by sex, the prevalence of malnutrition and malnutrition, the prevalence of stunting, etc. We think this will be very useful in reporting data from the Puskesmas to the Health Office."

Some nutrition workers also want the uploaded data to be continued with analysis, such as the amount of toddler data according to sex and age group, nutritional status data for children under 4 (four indicators), nutritional status data for children according to gender, and nutritional status data for children by age. Data analysis desirable presentation in graphical form.

"In the WHO Anthro application, there is a perfect module, namely the Anthropometric Calculator. It is better if the PSG toddler application also contains this module. It would be great if the PSG toddler application also includes graphic features on each indicator in calculating the nutritional status data for toddlers"

Besides, in addition to the application, a feature or module is provided that only provides facilities for assessing children's nutritional status individually. The nutritional assessment index is complete, including all indices in the WHO growth standard, such as indicators. Based on the results of problem identification, an android-based application will be designed. The need for both hardware, software, and ease of access by users is critical. The needs that will be analyzed include software, hardware for both the user, and the author as the maker.

1. Software requirements used by the author. Some of the software used by the author in developing this application, among others:
   - Java JDK 7u21 32-bit, which is a collection of Java programming language libraries
   - Android Development Tools Bundle for Windows ×64 In the form of a package (bundle) containing several components needed to create an Android-based application, these components include Android Studio, an editor used as a place to create android projects. Android SDK Tools and ADT Plugin
   - Using the existing gateway and webserver as a storage area on http://hoster.co.id
   - Using XML, PHP and WML as content programming, MySql as database
   - Office spreadsheet application (.xls), namely, LibreOffice ver. 6.3
2. Hardware requirements used by the author
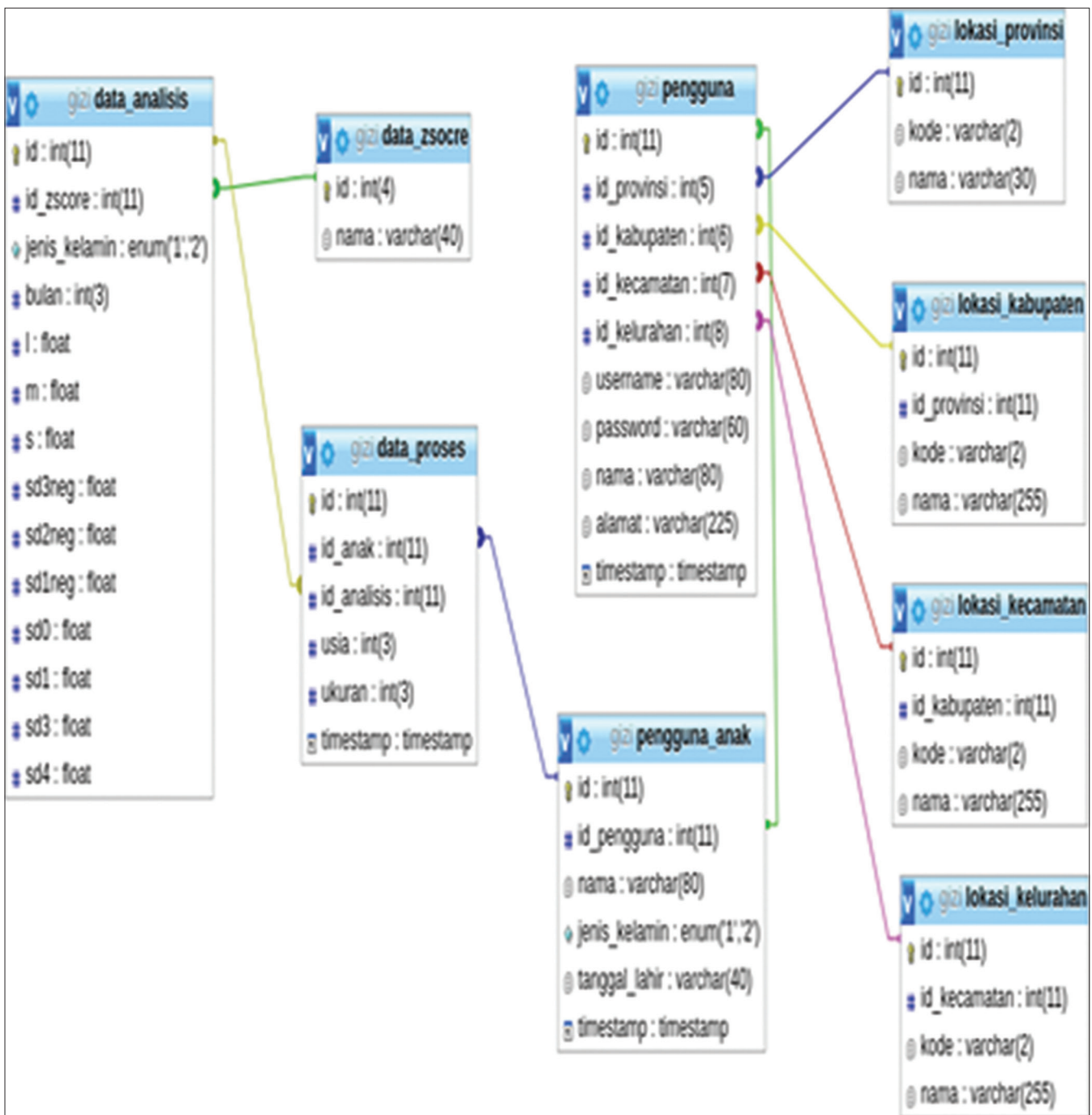   a. Notebook, with the following specifications:

Figure 2: Diagram of database relations in the PSG toddler application

- 15.6-inch TrueLife LCD screen with Full HD 1920 × 1080 pixel resolution
- Intel Core i5-8250U quad-core 1.6GHz TurboBoost 3.4GHz processor
- Intel Chipset, Intel UHD Graphics 620 Graphics and AMD Radeon 530 VRAM 2GB GDDR5
- 12GB DDR4 DDR4-2400MHz RAM memory
- 256GB SSD storage, SATA 1TB
- Connectivity, WiFi, Bluetooth, USB 3.1 port, USB 3.1 Type-C port, USB 2.0 port, HDMI port, audio port, DVDRW drive
- Original Windows 10 Home x64 Operating System

b. Smart Phone, with the following specifications:
- Processor: Mediatek Helio P60 Octa-core (4 × 2.0 GHz Cortex-A73 and 4 × 2.0 GHz Cortex-A53)
- Capacity: 64GB, with RAM: 4GB and Android 8.0 Oreo system
- Screen size: 6.23 inch, Dimensions: 156 × 75.3 × 7.8 mm
- Rear Camera: 16MP, Front Camera: 25MP
- Battery: 3400 mAh, with WiFI connection, WiFi direct, Bluetooth, Hotspot.

Figure 3: Application menu display

Figure 4: Account user interface

Structure and systems in the PSG toddler application

The application menu structure has an administrator page, and the application has a visitor page. The visitor page is a page that can be accessed by all visitors and becomes the core page of an application. In the developed application, this feature can be accessed by address through the application. The visitor page has a home menu, a nutritional calculator, and creates an account and a help menu. The following is the menu structure of the visitor page (Figure 1).

A visitor can see the front page (home) and try the features in the application. However, if visitors want to use the Nutrition Status Survey and profile features, they must first register (register) through the account creation process. After registering, the user can validate the username and password by logging in on the menu provided. It is intended that each visitor has one membership username.

The PSG toddler application's data processing uses the PHP language, which is integrated into the MySql database (Figure 2). This scheme is called the Entity-Relationship Diagram (ERD) design. ERD is a model to explain the relationship between data in a database based on primary data objects with relationships between relationships. ERD is used to model data structures and relationships between data. Some notations and symbols are used to describe it.

Furthermore, the algorithm design process is carried out using PHP to help calculation or problem solving systematically, and in programming activities, the algorithm is often considered logical in determining the program to be made according to database conditions. There are two essential algorithms, namely, the calculation of the nutritional status of children under five (for all indicators) using the LMS method, namely, the reference standard used by the WHO in determining nutritional status, with the following equation:

$$Z_{ind} = \frac{\left[y \big/ M(t) \right]^{L(t)} - 1}{S(t).L(t)} \quad (1)$$

Information:
- Z_{ind}: Represents the Z-score value on each indicator, namely BB/U; TB/U; BB/TB; body mass index (BMI)/U; LLA/U; and LK/U
- y: Measurement results in the amount of body weight (kg); height (cm); and BMI (kg/m^2)
- M (t): Absolute median value at the WHO growth standard reference standard for age or height
- S (t): Absolute sigma value in the WHO growth standard reference standard for age or height
- L (t): The absolute lamda value in the WHO growth standard reference standard for age or height.

The categories and result thresholds of the system process in the PSG toddler application after using the above equation will then refer to the Decree of the Minister of Health Number: 1995/Menkes/SK/XII/2010 concerning Anthropometric Standards for Assessment of Children's Nutritional Status, as presented in Table 2.

Table 2: Categories and thresholds for nutritional status of children under five

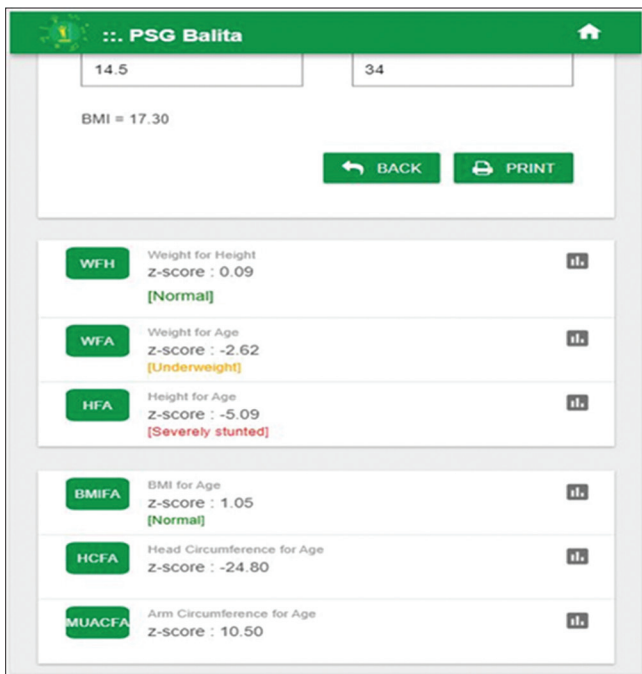| Index	Nutritional Status Category	Threshold (Z-Score)
Weight for Age (BW/U)	Malnutrition	<-3 SD
	Malnutrition	-3 SD–<-2 SD
	Good Nutrition	-2 SD–<-2 SD
	Gizi Lebih	>2 SD
Body Length for Age (PB/U) or Height for Age (TB/U)	Too short	<-3 SD
	Short	-3 SD–<-2 SD
	Normal	-2 SD–2 SD
	Tall	>2 SD
Weight according to Body Length (BW/PB) or Weight according to Height (BW/TB)	Very thin	<-3 SD
	Thin	-3 SD–<-2 SD
	Normal	-2 SD–2 SD
	Fat	>2 SD
Body Mass Index (BMI) by Age (U)	Very thin	<-3 SD
	Thin	-3 SD–<-2 SD
	Normal	-2 SD–2 SD
	Fat	>2 SD

Figure 5: Menu for nutritional status analys

PSG toddler application menu display

The menu display or interface in the PSG toddler application is designed to prioritize a good User Interface, which is an interface that is easy to understand and simple; the simpler an interface is and the easier it is to understand, the better the interface will be (Figure 3). The user interface makes it easy for users to interact with programs or applications. The PSG toddler application was developed as a form of convenience to users, namely, nutrition implementing staff at the public health center and society.

User account user interface

The create account menu is specifically used in calculating the nutritional status of children in groups, for example, the results of Posyandu activities or research data. Creating a menu account must be filled in very standard such as User Name, E-mail, Address, Password, and Confirm Password. Then after filling in, click REGISTER. The Nutrition Implementation Workforce (TPG) in the Kota Banda Aceh area agreed with the standard features when creating an account (Figure 4). According to them, the most important thing is to be able to process or analyze data on children's nutritional status.

User interface menu for nutritional status analysis

The interface provided on the Calculator menu is a list of fields related to toddler anthropometry. Such as data on birth date, visit data, gender, measurement position (measured), edema, weight (kg), height (cm), head circumference (cm), and upper arm circumference (ALL).
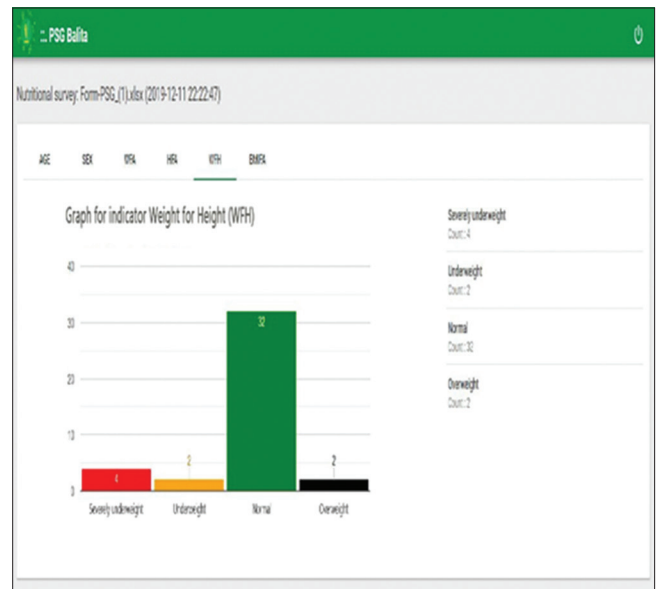

Figure 6: Nutrition statistics menu

After the anthropometric data are filled in correctly and adequately, the application immediately carries out a systematic process to input the nutritional status of children under six indicators, namely: Z-score index BB/U; TB/U index; index weight/height; BMI/U index; LLA/U index; and LK/U index (Figure 5).

The results of the discussions have been carried out, in the Calculator menu feature, it turns out that the TPG in the Banda Aceh City area wants not only the z-score to be generated from the calculation but also displays the category or nutritional status of the child on each indicator, and labeled with the appropriate color or refers to the Decree of the Minister of Health Number: 1995/Menkes/SK/XII/2010 concerning Anthropometric Standards for Assessment of Child Nutritional Status. According to TPG, if this can be displayed, it will make it easier for other users, such as the general public, to determine their children's nutritional status (Figure 6).

Table 3: Black box testing

No.	Test Group	Test Item	Result
1.	Applicative Instillation	Installation of applications on several different devices (24 users)	Success
2.	Core manu	- Main menu display - Nutritional calculator - Gia analysis	
3.	tensang information	Display about help and display about information	Success
4.	Exit	The button exits the application	Success
5.	Nutritional calculator	Provides information about infant azi status according to the index weight/age, weight/ height, height/age, BMI/U	Success
		Use of the graph/plotting features	Success (*Diupdate*)
6.	Account	User terdaftar dan bisa melakukan upload/ download	Success
7.	Natrious Analysis	Upload and Download	Success
8	Natricious Statictics	- Information on toddler data according to gender and age - Information on nutritional status data for all indicators - Information on nutritional status data for each indicator according to age - Information on nutritional status data for each indicator according to gender	Success (*Diupdate*)

Nutritional Status Analysis menu interface can be used when the user has successfully entered the system, and it is confirmed that the user has previously registered. This menu provides a template in nutritional status data entry using excel format (.xls). Furthermore, after filling in, the upload (export database) process is carried out again to the application, which aims to calculate Toddlers' nutritional status. This menu allows users to process nutritional survey data grouped according to index, age, gender, and cluster. The TPG in Banda Aceh City is more straightforward and has high efficiency in processing data from Posyandu results by interpreting the data in graphical form according to z-scores.

User interface of nutrition statistics menu

The TPG needs the PSG toddler application's interface to the nutrition statistics menu in the form of very important information at the Puskesmas in reporting nutritional status data. Some of the statistics used are:

1. The number of children by sex and age group is presented in the form of a pie chart
2. Prevalence of nutritional status in children under five based on each index.

Implementation of the PSG toddler application

The nutritional status monitoring application (PSG) for toddlers is implemented in nutrition implementers in Banda Aceh. The model used is Black box testing. Black box testing is testing software in terms of functional specifications without testing the design and program code. Testing aims to determine the functions, input, and output of the software according to the required specifications. Black box testing is done by making test cases that try all functions using the software according to the required specifications. Test cases created to perform Black box testing must be created with true and false cases (Table 3).

Discussion

Toddlers or babies under 5 years toddler of age are a critical phase in the human life phase. If there are health problems at that phase, then it is likely that these health problems will impact the next phase of life. In this context, toddlers' nutrition problems are also crucial problems to be addressed and need priority. The results showed that the application of the nutritional status monitoring application (PSG) for toddlers has a significant effect on the quality of nutritional data in Banda Aceh. The PSG toddler application also has a good effect in producing quality nutritional data, which is more specific to the nutritional status data for toddlers in Banda Aceh City. The nutritional status monitoring application (PSG) for toddlers has been implemented in Banda Aceh City's nutrition staff. The model used is through Black box testing. Black box testing is testing software in functional specifications without testing the design and program code.

Black box testing is done by making test cases that try all functions using the software according to the required specifications. Although many applications (applications) related to diet and nutrition are available from the major smartphone platforms, relatively few have been tested in research studies to determine their effectiveness in promoting health [14]. The use of nutrition applications provides better outcomes, including knowledge and behavior, among healthy adults [15]. The mobile application is currently an effective and efficient self-monitoring tool in monitoring nutrition, especially weight loss [16]. The existence of health technology applications impacts the quality and quality of work processes, besides increasing the value of efficiency. This increase starts from understanding and positive responses and having the ability to generalize, and the value of the level of effectiveness is significant. Android-based training and application using the PSG toddler application as a form of human resource development have a mission to maximize the Puskesmas TPG to carry out its primary duties and functions as a nutritionist in serving the community. It is also intended that the purpose of training and application of this application is to provide the latest information related to the use of WHO-2005 growth standards and increase organizational commitment through cognitive changes for individual nutritionists in Puskesmas in the city of Banda Aceh. The PSG toddler application's data processing uses the PHP language, which is integrated into the MySql database. Algorithm programming activity as logic in determining the program to be made according to database conditions. There are two essential algorithms, namely, the calculation of children's nutritional status under five (for all indicators) using the LMS method, namely, the reference standard that has been used by the WHO in determining nutritional status, and the second is the algorithm for calculating age (months).

The menus in the PSG toddler application are designed to be easy to understand and simple; the simpler an interface is and the easier it is to understand, the better the interface will be. Furthermore, the user interface must make it easy for users to interact with programs or applications. The PSG toddler application was developed as a form of convenience to users, namely nutrition implementing staff at the Puskesmas and society. Implementing the PSG toddler application using the black box method shows that all features are successfully executed. However, one feature fails, namely, the nutritional calculator feature on the use of graphs/plotting, which cannot be executed. So that improvements will be made to this feature. Rapid technological developments have encouraged the use of smartphones in health promotion research and practice. The use of growth monitoring and

promotion (GMP) has expanded to halve hunger and reduce child mortality by two-thirds by 2015 [17]. Inclusion in existing GMP programs will help increase children's nutritional intake and reduce malnutrition prevalence [18]. The development of health promotion applications and various mobile features that support health behavior change offers a new and innovative approach to weight management in childhood [19]. Smartphone apps may be an innovative medium for delivering individual health behavior change intervention en masse. Researchers or health professionals considering developing an app in their area must give careful consideration to the target population in terms of their access, ability to adopt this form of intervention, and preferences regarding the design, the current technologies available for app development, existing commercial apps, and the possibility that their use will be irregular and short-lived.

Conclusion

Identification of the need to design an Android-based application, especially the PSG toddler application, must be based on the user's convenience and be more user-friendly. Besides identifying the PSG toddler application's needs by other nutritional status monitoring programs in calculating nutritional status, it is mandatory to include four indexes consisting of the weight/age index, TB/U index, index BB/TB, and index BMI/U.

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