International Journal of Allied Medical Sciences and Clinical Research (IJAMSCR)

ISSN:2347-6567

IJAMSCR |Volume 11 | Issue 1 | Jan - Mar - 2023
www.ijamscr.com

Research article ***Medical research***

Monitoring the Growth and Development of Toddlers Aged 1-24 Month Using the Android-Based Bigmom Application

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ABSTRACT

BACKGROUND: The current nutritional situation in Indonesia is still problematic with being underweight, stunting, and wasting, so children's growth and development must continuously be monitored, especially during the *Golden Age*. Monitoring the growth and development using the BigMom application is expected to help make it easier for mothers to monitor the growth and development of their children. This application can also be the right technology for millennial mothers, most of who currently use smartphones because they are efficient and can be used anywhere and anytime.
AIM: This study aims to create the BigMom application, which is an application to monitor the nutritional status of toddlers' growth and development based on Android smartphones.
METHOD: This research method uses Research and Development (R&D) and accuracy tests on the system. The study subjects used 96 respondents of mothers who had toddlers children at the Pudak Payung Health Center, Central Java, Indonesia.
RESULT: The trial of the application system using the accuracy test showed an accuracy of 96.8%, as shown from the results of the comparison of manual monitoring with the KMS graph in the KIA book, and the application 93 data had been declared appropriate from 96 data that had been tested.
CONCLUSION: The toddler growth and development monitoring application for ages 1-24 months using the android-based BigMom application has proven to be suitable for mothers with toddler children to monitor the growth and development of their children.

Keywords: *Toddlers, BigMom Application, Growth Monitoring, Growth and Development Nutritional Status.*

INTRODUCTION

The current nutritional situation in Indonesia is still problematic, with being underweight, stunting, and wasting[1]. Information about the nutritional status of children must continuously be monitored, especially in the first 1000 days of a child's life, because this time is the golden age or what is called the Golden Age, Critical Period, and window opportunity[2]. The golden age or the first 1000 days of life, is a time when a child's growth and development occur very significantly and quickly, so sometimes some parents do not realize that their child has a growth delay[3,4].

UNICEF, WHO, and the World Bank in 2020 reported that globally there are 144.0 million children under five suffering from stunting[5]. UNICEF also estimates that more than half of children under the age of 5 who suffer from stunting are in the South Asian region, while 2 in 5 stunted children live in Africa[5]. In 2020, in Indonesia, the prevalence of stunting toddlers was 1.3 million toddlers stunting from a total of 11,499,041 toddlers who were weighed and measured their nutritional status[6]. The data is in line with Riskesdas in 2018, which stated that the highest stunting prevalence area is the East Nusa Tenggara region (42.6%), followed by the West Sulawesi region (41.8%)[1,7]. Meanwhile, the prevalence rate

of stunting toddlers in Central Java in 2020 is also relatively high, namely 13.8%[6].

Monitoring the nutritional status of children's growth and development is an effort that must be made, especially by mothers and health workers. Monitoring the nutritional status and growth and development of children has been carried out by bringing toddlers to posyandu for the process of weighing babies and recording anthropometric data manually on anthropometric graphs in the KIA book[8,9]. The method of managing growth and development data that is still conventional is considered less effective because it has many weaknesses, such as unclear writing, errors in writing children's weighing data, and can cause a buildup of paper containing data[10]. The KIA book in the form of sheets of paper as a medium for recording data is also considered less effective because it is easily damaged and lost [11,12].

The problem of the quality of data on the nutritional status of toddler growth and development and the conventional data management process is considered less practical and efficient in the speed and accuracy of monitoring the growth and development of toddlers. Therefore, it is necessary to design a mobile-based application to monitor the growth and development of toddlers that are user-friendly for mothers who have toddlers and health workers.

Smartphones or mobile devices are currently the fastest-growing technology and the majority of Indonesians have them [13,14]. Smartphones in the 4.0 era are more widely used devices compared to computers or landlines [15]. Based on data from the Ministry of Communication and Informatics, there are 167 million (90.75%) Indonesians using smartphones, and each household has at least one smartphone[15,16]. The high number of smartphone users in Indonesia is undoubtedly very profitable if it is used as a medium for health information and monitoring the nutritional status of toddler growth and development[17]. The use of smartphones can be an easy, practical, and efficient solution as a medium of information and monitoring the nutritional status of toddler growth and development[18].

The BigMom application as a tool for monitoring the nutritional status of toddler growth and development is certainly very useful for mothers who have toddlers and midwives, so that mothers can get information quickly and midwives can also detect early and take further actions if disturbances are found in the growth and development of toddlers. This BigMom application helps improve the quality of service and monitor the nutritional status of toddlers' growth and development in two ways. First, assisting cadres and midwives in monitoring the nutritional status of children with more accurate and fast data[19]. Second, helping mothers to get information, counseling and recommendations related to the results of monitoring nutritional status with higher quality, besides that writing manuals in the KIA book can be replaced simply and practically when using the BigMom application which can be run in android-based applications. Another advantage of using the Android-based BigMom application is that it is easy to carry and can be accessed anywhere and anytime [20].

METHOD

This research uses the Research and Development (R&D) method. The R&D method is used to produce a specific product, be it developing a previously existing product or a new product, and then testing the effectiveness of the product.

This research stage refers to the Borg and Gall method modified by Sugiyono. The first stage is to collect data and information, then design an application system model. The next step carried out is validation by experts in accordance with the design of the BigMom application, namely IT experts, midwives and nutritionists. The BigMom application that has been validated by an expert is then tested by the application. The data analysis carried out consists of the stage of data reduction, data presentation, and drawing conclusions.

The BigMom application trial was conducted by applying to 96 participants, namely mothers who had babies aged 1-24 months. This research was conducted in the working area of the Public Health Centre in Pudak Payung, Central Java Province. The research time starts from February – June 2022.

Ethical Clearence

Ethical clearance in this study is carried out with the approval of the research ethics committee. This research has been submitted and ratified ethical clearance by the health research ethics committee of the Ministry of Health of Semarang Ministry of Health No. 0579/EA/KEPK/2022 on June 21, 2022.

RESULT

Respondents' Characteristics

The distribution of respondents' characteristics in this study includes age, education, and occupation. The respondents were 96 people, consisting of mothers with children under five aged 1-24 months. Characteristics of respondents can be seen in Table 1.

Table 1 Characteristics of Respondents

No	Characteristic	N	%	Std. Deviation
1.	Age			.039
	< 20 Years	7	7,3%	
	21-35 Years	82	85,4%	
	>35 Years	7	7,3%	
2	Educational Status			
	Elementary	1	1%	
	Junior High School	21	21,9%	.068
	Senior High School	57	58,3%	
	D3/S1	19	18,8%	
3.	Occupation			

Having Job	25	26%	.045
Jobless	71	74%	

Table 1 shows that 7,3% of respondents were under the age of 20 years, 85% were respondents aged 21-35 years with 82 people and 7,3% were over 35 years old. Most of the respondents' education was in senior high school, which was 58,3% or 56 people. The number of respondents who worked was only a small 26%, while the remaining 74% were not working.

System Design

The design of the built system can be seen in the use case diagram in figure 1. The use case diagram illustrates the stages that can be done by the user (the mother who has a toddler) to the system.

This BigMom application system's users are mothers with toddlers aged 1-24 months.

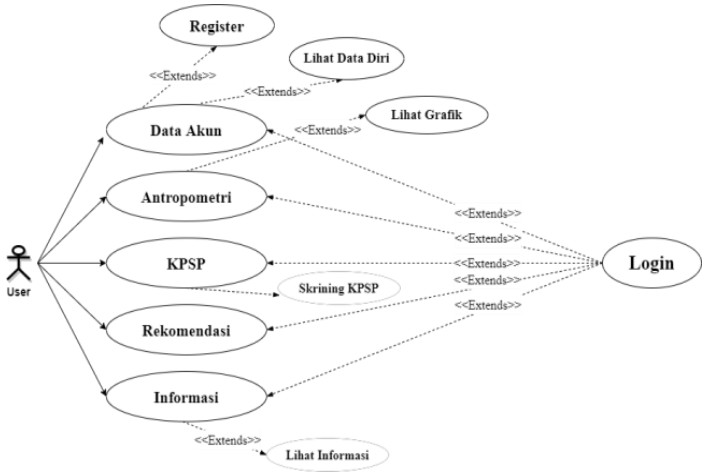


Fig 1: Use Case Diagram

BigMom App View

Sign-in Page

The "BIG MOM" application login page to monitor the nutritional status of the growth and development of toddlers aged 1-24 months consists of an email and password. For users who have already registered or registered on the BigMom application, they can immediately fill in the login, but for new users, they can register first by pressing a click on the list text.

The start page of the BigMom app can be seen in Figure 2.



Fig 2: BigMom App Start Page

Registration Page

The registration page can be seen in figure 3. Users who are using the BigMom application for the first time can register by filling out the identity in the form of full name, date of birth, gender, birth weight, and current weight.



Fig 3: Registration Page

Anthropometry Menu

The Anthropometry menu can be seen in Figure 4. This anthropometric menu contains KMS graphs to monitor the nutritional status and growth of toddlers. Users will be asked to fill in the child's weight data then the application will calculate automatically and provide a conclusion on the child's nutritional status based on the z-score calculation. Z-score is a basic calculation formula used by WHO as a reference standard in determining the nutritional status of babies, with the following equation:

$$Z\text{-}score = \frac{\text{NIS}-\text{NMBR}}{\text{NSBR}}$$

Information:

NIS :Individual Values of Subjects
NMBR :Reference Standard Median Value
NSBR :Reference Standard Error Value

The categories and thresholds of system process results on the Android-based BigMom application after using the equations above will then refer to the Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2020 concerning child anthropometric standards, as presented in Table 2.

Table 2: Categories and Thresholds of Nutritional Status of Children Under Five

Indeks	Kategori Status Gizi	Ambang Batas (Z-Score)
Weight by Age **(BW/U)**	*Severely Underweight*	<-3 SD
	Underweight	-3SD sd < -2SD
	Good Nutrition	-2SD sd +1SD
	Risk of More Weight Loss	> +1SD
	Severely Underweight	<-3SD
Body Length by Age atau Height by Age **(TB/U)**	*Severely Stunted*	<-3 SD
	Stunted	-3SD sd < -2SD
	Normal	-2SD sd +3SD
	Tall	> +3 SD
Weight by body Length **(BW/PB)** or Weight by Height (**BW/TB)**	*Severely Wasted*	<-3 SD
	Wasted	-3SD sd < -2 SD
	Good nutrition	-2SD sd +1 SD
	Possible risk ofoverweight	>+1SD sd +2 SD
	Overweight	> +2SD sd +3SD
	Obese	> + 3 SD
Body Mass Index by Age **(BMI/U)**	*Severely Wasted*	<-3 SD
	Wasted	-3SD sd < -2SD
	Good nutrition	-2SD sd +1 SD
	Possible risk ofoverweight	>+1SD sd +2SD
	overweight	>+2SD sd +3SD
	Obese	> +3 SD

The categories and thresholds for the nutritional status of toddlers above are used as a determination of the nutritional status of toddlers, so that then the BigMom application system will display a graph of weight gain and conclusions and recommendations related to the current nutritional status of toddlers. Figure 4 shows a graph of children's weight gain every month.

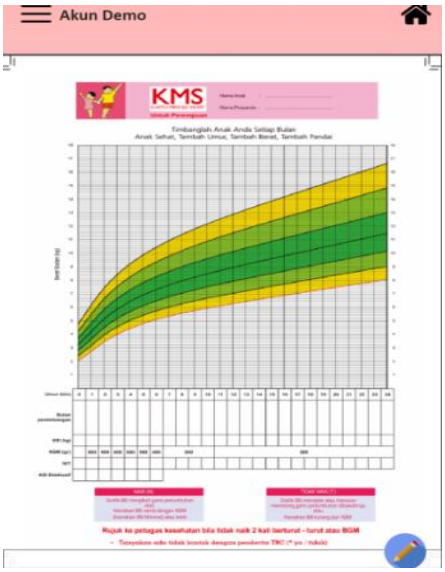


Fig 4: Anthropometric Menu KMS Graph

BigMom App Implementation

The BigMom application to monitor the nutritional status of the growth and development of toddlers was implemented for 96 mothers who have toddlers using android-based smartphones. This application system is evaluated and tested for its implementation by calculating the accuracy of the system. The accuracy of the system can be known through the confusion matrix table. This accuracy test is carried out to determine the accuracy of using the system. The results of the BigMom application system accuracy test are shown in Table 3.

Table 3: System Accuracy

n= 96	Actual (Y)	Actual (N)
Deviation (Y)	9	0
Normal (N)	3	84

Based on the results of the trial on 96 respondents by calculating accuracy with the confusion matrix formula, the accuracy was obtained at 96.8%. The Confusion matrix formula as the basis for calculating the accuracy of the BigMom application above is described in the following equation:

$$Accuracy = \frac{TP + TN}{TP + FP + FN + TN} \; x\; 100\%$$
$$= \frac{9 + 84}{9 + 0 + 3 + 84} \; x\; 100\%$$
$$= 96{,}8\%$$

Information:
True Positive (TP) : The amount of data that is positive and predicted to be true positive
False Positive (FP) : Negative but predicted positive data count
False Negative (FN) : Number of positive but predicted Negative data
True Negative (TN) : The amount of negative and predicted negative data

DISCUSSION

Monitoring the nutritional status of growth and development of children under five in the first 1000 days of life is a crucial stage because in this phase growth and development are very rapid and can affect a person's life[18,21,22]. Therefore, monitoring the growth and development of toddlers is very necessary to prevent deviations that can result in adverse effects such as autism, stunting, down syndrome, etc.

The development of technology today, especially smartphones has been very rapid and developed a lot, so it has transformed into an information system center, especially in the health sector[2,22,23]. By using this "BIG MOM" application, it can make it easier to monitor the nutritional status of toddler

children because it can be accessed at any time, anytime and anywhere, and it is also hoped that mothers who have toddlers will be able to do their own monitoring.This BigMom application is a user-friendly application so that it is easily operationalized by all users, both mothers who have toddlers or midwives as health workers. The way this application works is straightforward because if the user is using the BigMom application for the first time, the user only needs to register, namely filling in the identity of the child and the identity of the parents and for users who already have an account can immediately log in using email, then the data will be stored in the database and will not be lost so that the weight history will continue to be monitored. Users who have registered can input the child's weight every month on the anthropometric menu, which then the system will categorize the child's nutritional status automatically. A graph of children's weight gain will be attached so that users can see the difference in weight gain and then there is also written information about the monitoring results, recommendations and suggestions are also given according to the results of the nutritional status of toddlers.

The android-based BigMom application has been implemented for 96 mothers who have toddlers aged 1-24 months in the work area of Public Health Centre Pudak Payung, Semarang, Indonesia. The model used is accuracy testing with confusion matrix equations to see the accuracy of the results of the nutritional status of toddlers and their graphs. Although many applications related to nutrition and growth and development are available from the main platforms of smartphones, relatively few have been tested in research studies to determine their effectiveness[1]. The use of the BigMom application after being implemented showed a high accuracy rate of 96.8%. The results of this accuracy test are more significant than the previous research conducted by Fadilla, et al (2018) on the identification of child growth and development deviations with the Backpropagation algorithm, whose accuracy test results were only 91.11% besides that in a similar study with the title of an expert system to detect the growth and development of children aged 0 to 2 years based on android getting the results of the application accuracy score of 70.75%[24,25]. Based on these results, of course, it can be concluded that the android-based BigMom application to monitor the growth and development of toddlers is proven to be able to help toddler mothers, posyandu cadres and midwives to monitor the nutritional status and growth and development of toddlers effectively and efficiently, wherever and whenever.

With the BigMom application, the benefits obtained are beneficial to make it easier for mothers to monitor weight gain and nutritional status, detect growth and development deviations and provide recommendations to children anywhere and anytime using a smartphone. In addition, based on a study entitled Smartphone-Based Maternal Education for the Complementary Feeding of Undernourished Children, it is stated that using smartphone technology can be a cost-effective platform for the distribution of health information[26].

CONCLUSION

The android-based BigMom application to monitor the growth and development of toddlers aged 1-24 months can be relied on efficiently to monitor the nutritional status and growth and development of toddlers aged 1-24 months. This android-based BigMom application is suitable for monitoring the nutritional status and growth and development of children under 1-24 months of age, as evidenced by the results of the application's high accuracy test of 96.8%. The toddler growth and development monitoring application for ages 1-24 months using the android-based BigMom application has proven to be suitable for mothers with toddler children to monitor the growth and development of their children.

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