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Innovative android application for anthropometric assessment of nutritional status in boys aged 0-59 months

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ABSTRACT

Background: *Smartphone users in Indonesia mostly use smartphones to access mobile applications rather than mobile websites. As many as 82% of smartphone users in Indonesia access mobile applications while the remaining 9% of users each access mobile websites and websites via desktop. The majority of the population of smartphone users who access mobile applications come from productive age, namely 75% from 18-24 year olds and 79% from 25-34 year olds. The survey results prove that the development of information technology in mobile technology has developed rapidly. These technological developments have resulted in changes and developments in all fields, one of which is the health sector.*
Objectives: *The aim of this research is to design and create Android-based anthropometry of nutritional status aged 0-59 months. which can be downloaded via the cell phone used by Posyandu cadres.*
Methods: *This research developed an innovative Android application to assess the nutritional status of boys aged 0-59 months using the Waterfall development method in the Software Development Life Cycle (SDLC). This approach starts from requirements analysis, system design, coding, testing, to implementation and maintenance, which is carried out in a linear and gradual manner to ensure that each phase of development runs in a structured manner and produces effective and high-quality applications.*
Results: *The research results show that this anthropometric application significantly increases the efficiency and effectiveness of Posyandu cadre service time. By reducing the need for manual recording and calculations, this application speeds up the process of assessing the nutritional status of children aged 0-59 months, reduces errors, and allows cadres to focus more on direct interactions with mothers and children, thereby improving the overall quality of services.*
Conclusions: *Android-based Anthropometric Application for Nutritional Status Age 0-59 Months is a digital tools.*

KEYWORD: anthropometric assessment; nutritional status; android application;

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INTRODUCTION

Child anthropometric standards in Indonesia refer to the WHO Child Growth Standards for children aged 0-5 years and The WHO Reference 2007 for children 5-18 years. These standards show how a child's growth can be achieved if certain conditions are met. Research shows that children from any country will grow the same if proper nutrition, health and parenting are met. The benefits of this standard are 1) as a reference for health workers to identify children at risk of growth failure without waiting until the child suffers from nutritional problems 2) as a basis for supporting health policies and public support related to preventing growth disorders through promoting breast milk and food programs. accompanying breast milk and implementing healthy living behavior(1).

Anthropometry is a science that studies various sizes of the human body. In the field of nutrition, it is used to assess nutritional status. The measurements that are often used are body weight and height. Apart from that, there are also other body measurements such as upper arm circumference, fat layer under the skin, knee height, stomach circumference, hip circumference. These anthropometric measurements can stand alone to determine nutritional status compared to standards or in the form of indices by comparing other measurements such as BW/U, BW/TB. TB/U.

In general, anthropometry means the size of the human body. Viewed from a nutritional perspective, nutritional anthropometry relates to various measurements of body dimensions and composition at various ages and levels of nutrition. Anthropometry is a field of science that deals with the dimensions of the human body. These dimensions are divided into statistical groups and percentile measures. If a hundred people stood in a row from smallest to largest in some order, this would be classified from 1 percentile to 100 percentile. This human dimension data is very useful in product design with the aim of finding product compatibility with the humans who use it(2).

The main concern is preparing and improving the quality of the working age population so that they really have the opportunity to play a role and have the ability to participate in development efforts (3). One important effort to make this happen is development in the health and nutrition sector. Anthropometry as a technique was first developed among biological anthropo-ogists, now its application touches various fields including medicine, sports, nutritional anthropology, nursing and pediatrics in the science of child growth. Anthropologists such as Tanner, Bogin, Boucher, Malina, and Uli Jaszek developed anthropometric techniques that were linked to the theory of human growth from intra-uterine to late adolesentia (around 20 years). The application of anthropometry as a bioanthropological method to medicine becomes meaningful if accompanied by an adequate theoretical background regarding growth. When used to assess nutritional status, anthropometry is presented in the form of indices, for example

body weight for age (WW/U), height for age (TB/U) and so on(4).

Integrated Service Post (Posyandu) is a health service to make it easier for the public to find out or have health checks, especially for mothers and children under five. The baby's health that needs to be monitored is the baby's nutritional status. Nutritional status is a health status resulting from a balance between nutritional needs and input (5). Cadres are part of the posyandu implementers. Technically, the duties of cadres related to nutrition are collecting data on toddlers, weighing them and recording them in the Healthy Way Card (KMS), providing additional food, distributing vitamin A, conducting nutritional education and visiting the homes of breastfeeding mothers and mothers with toddlers. Cadres are expected to play an active role and be able to become drivers, motivators and community counselors. In the industrial era 4.0, cadres are required to provide effective and efficient services. The development of mobile computing technology has led to the creation of smartphone devices with the Android operating system. The technology on these devices allows every individual to access the internet, send e-mail, open documents in electronic/ebook format, socialize through social media applications, enjoy various entertainment and even play games. Android itself is an operating system for Linux-based smartphones that provides an open source platform complete with various tools and APIs (application programming interfaces)(6).

Many Android-based applications have been developed in various fields because they have the advantage of being able to be accessed using a smartphone connected to the internet anywhere and anytime by anyone. Moreover, the use of smartphones is increasing from time to time in line with the increasing sophistication of technology with a variety of new features and relatively affordable prices (7). One of the smartphone features is that it can be used to install Android-based applications, including the application developed in this research. An Android-based application for anthropometric nutritional status of toddlers was designed and built so that posyandu cadres can easily collect anthropometric data on nutritional status of toddlers in posyandu services(8)

In the current health system, measuring the nutritional status of children often faces various challenges, particularly in terms of time efficiency, accuracy, and the availability of skilled personnel at health facilities such as Posyandu. Manual anthropometric measurements tend to be time-consuming and prone to errors, both in measurement and in calculating the nutritional status index. This can delay the handling of nutritional issues, which is crucial for children aged 0-59 months, a group vulnerable to stunting and malnutrition(9).

The use of Android technology as a solution in this research addresses the issues of efficiency and accuracy. An Android-based anthropometric application can be accessed by Posyandu cadres without requiring

expensive equipment or intensive training. This application allows for faster and more accurate measurements, automatically calculating nutritional status based on anthropometric data such as weight and height. With automation features, the risk of calculation errors can be minimized.

Moreover, the application offers a user-friendly interface, making it easy to use for healthcare workers and Posyandu cadres who may have limited technical expertise. Android technology, connected to a database, enables continuous data storage and tracking of children's progress, providing reports that can be accessed at any time. This adds value to long-term monitoring and continuous tracking of nutritional status (10).

The novelty of this research lies in the integration of modern technology with the practical needs of child health services at the community level. In this context, the Android-based anthropometric application not only offers a technical solution but also empowers health cadres to deliver more effective and structured services. The results of this study are expected to pave the way for similar technologies in other regions with limited health infrastructure(11).

Thus, the implementation of this application could be an innovative step toward accelerating efforts to prevent stunting and malnutrition in children aged 0-59 months, especially in areas that need practical and efficient solutions. The widespread use of this application has the potential to improve the quality of basic health services and help the government achieve national nutritional targets.

Many people have implemented feasibility studies for applications using Android because they are more effective and efficient than paper. The feasibility process will be carried out according to the flow until the trial is carried out (12). Based on a preliminary data survey conducted at 17 Community Health Centers spread across Baubau City, Wajo Community Health Center is the first community health center that has the largest number of posyandu. The Toddler Posyandu is scheduled every month with a total of 391 toddlers with a cadre of 32. The high stunting rate provides a role for health workers, especially cadres on the front line, as part of the anthropometric recording that is carried out. At the Wajo Community Health Center, PB/U, TB/U recording is carried out 4 times a year (January, April, August and December). The design of this application is expected to know the nutritional status of children, height according to age PB/U, TB/U to detect stunting. Based on the background description above, researchers are interested in conducting research with the title "Android-based Anthropometric Design for Nutritional Status Age Status 0-59 Months".

MATERIALS AND METHODS

The research design uses quantitative methods. The research instrument was a questionnaire for software testing via Google form which was distributed to. Posyandu Cadres at the Wajo Health Center. The

sampling technique used the Total Sampling technique. The total population is 10 posyandu cadres. Data collection was carried out using literature studies by reading existing literature and looking for additional literature that was used to deepen the material. Then after that examine and interpret the sources, as theories related to the research problem. Tools used: (1) Software used is based on Android Studio and SQLite. (2) Hardware used is PC with Intel Core i7 Processor specifications, 12 GB RAM, 250 GB SSD hard disk.

This research is development research by developing Android-based anthropometric software for nutritional status aged 0-59 months to make it easier for posyandu cadres to provide posyandu services, especially in measuring height (TB), body weight (BB) and age (U) as well as assessing nutritional status. children aged 0-59 months. This stage, what has been carried out is only the application design concept stage based on PMK No.2 of 2020 concerning Children's Anthropometric Standards which will be carried out at the next stage, namely theoretical concept analysis to be included in the software being built. The method used, namely the Waterfall method at the Software Development Life Cycle (SDLC) stage includes: analysis, design, code creation, testing, implementation and maintenance. At this stage, that is done : (1) *Requirements & Analysis*: This phase is gathering requirements and analyzing all the requirements for the application/system to be developed (2) *Design*: In this phase, a system/application design will be carried out in accordance with the needs identified in the previous phase. The designs that have been created include system/application design and interface design(3). System testing This phase is testing the overall application/ system that has been created. Testing is carried out to find out whether this system/application meets your needs or whether there are still deficiencies If a system discrepancy is found, a system/application revision will be carried out (4) *Implement/Deploy*: This phase is carried out after the system has been tested and the results are in accordance with the specified needs. *In this phase, the application is used by installing it on the Android device* (5) Maintenance: This phase is system/ application maintenance.This phase is carried out so that the system/application is always maintained and meets the needs of its users This asset can be revised at any time if necessary according to needs.

RESULTS AND DISCUSSION

RESULTS

This research produces an Android-based system that is built based on the system requirements that have been obtained. System testing uses the Android Oreo OS platform with 2 GB RAM capacity, 16 GB internal memory, minimum screen size of 5 inches. The working system of this application is that it contains publications consisting of text, images and published in digital form that can be read by mobile

phones. This application is software developed for Android-based cellphones/ tablets. In the initial display, when the application is first opened the user will display the application name, PB/TB input column (cm), Age input column (Months), a calculation button and a description button to continue to the next page.

The initial display can be seen in the image below:

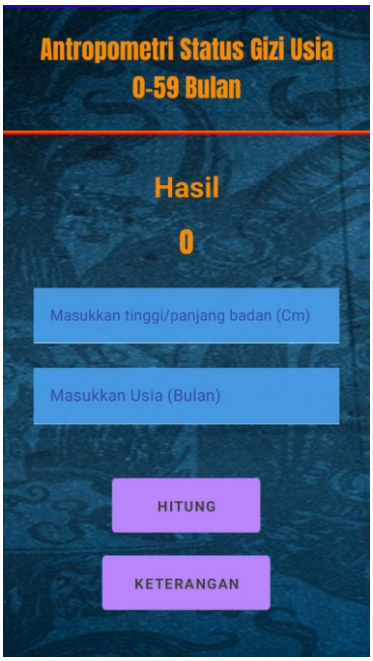

Figure 1. Menu Display

Button Description The age used is the age calculated in full months, for example if the child is 2 months 29 days old then it is calculated as 2 months old. **0-24 Months Measurement of Body Length (PB**) when the child is lying down in units (cm).When measured in a standing position, the measurement results are corrected by adding 0.7 cm. **25-59 Months Height (TB)** measurements are taken when the child is standing in units (cm). If measured in the supine position, the measurement results are corrected by subtracting 0.7 cm.

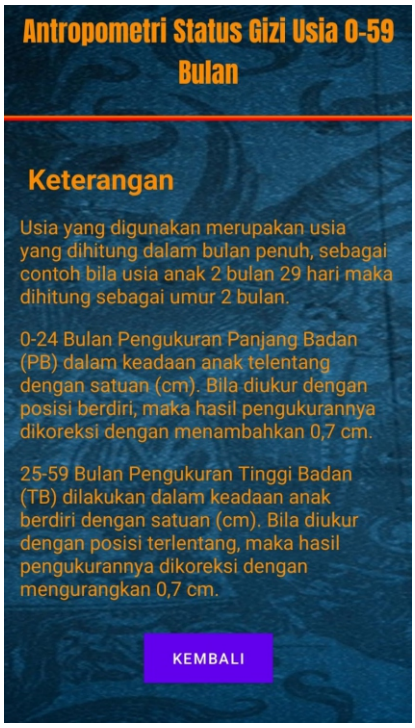

Figure 2. Information about Age, Body Length/Height

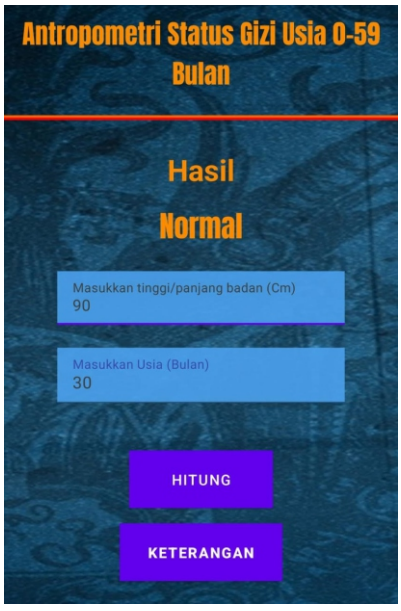

Figure 3. Button Description

The Android-based Anthropometric Application for Nutritional Status Age Status 0-59 Months is designed to be used by health workers, Posyandu cadres and the general public who have children under five to control growth, especially boys. This application is software developed for Android-based cellphones/tablets. This digital application is equipped with a description button that provides information on how to use it.

DISCUSSION

Figure 1 show that the development of an Android-based anthropometric application for assessing the nutritional status of boys aged 0-59 months is an innovation that has great potential in the field of public health. This application is designed to facilitate anthropometric measurements which include age, body length (PB)/body height (TB), body weight (BB), head circumference and body mass index (BMI). However, this study used 2 parameters, namely Age and Body Length (PB)/Height (TB). This development aims to simplify the process of monitoring nutrition in toddlers by using technology that is easily accessible to health workers and parents(13).

Data validation and accuracy in the trial phase of this application have been tested on sample populations with various categories of nutritional status, ranging from malnutrition to overnutrition. The results show that this application is able to provide accurate and consistent results compared to conventional methods that use manual measuring devices. The accuracy of this application is verified through validation tests with WHO standards which show minimal deviation between application data and manual measurements(14).

Ease of use by health workers and parents is one of the main advantages of this application ' (15). The intuitive interface is designed to be used by various groups, both health workers with a medical background and parents without a special background. Users simply enter basic data on the child's age and PB/TB, then the application will automatically calculate and provide an interpretation of the child's nutritional status. This feature provides added value in the context of monitoring nutrition at the population level, while supporting efforts to prevent stunting and malnutrition at the national level(16).

This application is designed with a flexible design so that it allows updates and further development. Features such as long-term monitoring, reminders for routine check-ups, and nutritional education for parents will be part of this application update. This development will be carried out in stages based on feedback from users and technological developments(17).

Figure 2 show that previous studies have highlighted the challenges in assessing nutritional status in children aged 0-59 months using traditional methods. Anthropometric measurements, which typically rely on manual tools like measuring tapes and scales, have been prone to human

error and inaccuracies in calculating essential indices like weight-for-height or weight-for-age. The traditional approach often takes more time and requires specialized training, limiting its effectiveness in remote or underserved areas(10).

Research has also shown that health facilities, especially community-level services such as Posyandu, face constraints in human resources and equipment. This results in delays in monitoring children's nutritional status and responding to cases of mal-nutrition or stunting. Manual data recording and analysis processes further slow the system down, making it difficult to generate real-time assessments for timely inter-ventions.

With the rise of mobile health applications (mHealth), several studies have explored how digital solutions can improve anthropometric assessments. Highlighted that mobile applications offer the potential to reduce human error and increase the speed of data processing, ensuring real-time access to important health metrics. However, challenges remain in the usability and accessibility of these applications, especially in low-resource settings.

Introduced the concept of integrating mobile platforms with health programs to improve child nutrition assessment. Their study showed that using digital tools significantly reduced the time required for nutritional status assessments and improved data accuracy. Nonetheless, their application lacked adaptability for community-based use, requiring further improvements to suit less tech-savvy users like Posyandu cadres(11).

Focused on the potential of Android-based applications in low- and middle-income countries, emphasizing their ease of use and widespread availability. Their study demonstrated how Android platforms can be leveraged to automate anthropometric calculations and provide healthcare workers with real-time data analysis, making it easier to monitor and assess nutritional status even in remote locations(18).

Expanded on this by incorporating user-centered design principles in the development of mobile health applications for nutritional assessments. They found that designing for the end-users' specific needs, such as healthcare workers in rural areas, resulted in greater adoption and reduced user errors. However, they noted that there is still a gap in studies focused on integrating these digital solutions at the community level for routine use(9).

Challenges in Implementation This has many advantages, implementing this application in the field faces several challenges, such as limited internet access in remote areas and resistance from some health workers to new technology. To address this, intensive training and outreach is required to ensure widespread acceptance and optimized use of the application(19).

The impact on children's health of using this application has the potential to have a significant impact on improving the nutritional status of children, especially in

areas with limited access to health facilities. With easier and more routine monitoring, early detection of nutritional problems can be done so that intervention can be given immediately to prevent further complications (20). Initial feedback from users shows high satisfaction with the application, especially in terms of ease of access and speed of getting results. Parents who use this app report an increase in their awareness of the importance of monitoring children's nutrition, which can indirectly improve child feeding and care practices at home (21).

Figure 3 show that anthropometric research application makes a significant contribution to research by providing structured and easily accessible data. Data collected through this application can be used for further research regarding child growth trends and factors that influence nutritional status, both at the local and national level (22). Integration with health systems to increase its effectiveness, this application is also integrated with wider health information systems, allowing health workers to access child data in real-time and provide more targeted interventions. This integration supports a holistic approach in handling nutritional problems in children (23).

Research by Gogia & Sachdev discussed the importance of mobile health (mHealth) applications in improving the efficiency of nutritional assessments. They found that the use of mobile applications reduced manual errors in anthropometric calculations and accelerated the nutritional assessment process in children (24). Additionally, these applications provided real-time access to crucial health data, enabling healthcare workers to respond quickly to malnutrition conditions. Thus, the Android-based application developed in this study offers a faster and more accurate solution compared to traditional methods, which require manual recording and longer processing times (10).

Lemos et al. continued by investigating how digital applications can be integrated into child health programs at the community level. They found that digital applications significantly reduced the time needed for nutritional status assessment and improved the accuracy of the data collected. However, their research revealed that current applications are not well-suited for use by healthcare workers in rural areas. The development of an Android-based application in this study provides a solution with a more user-friendly interface, specifically designed for the needs of healthcare workers in remote areas, making it easier to adopt by users with minimal technological skills (11).

Sarmento et al. emphasized the importance of user-centered design in developing mobile health applications. They found that applications designed based on the needs of end-users, such as healthcare workers in rural areas, not only increased adoption but also reduced errors in usage. The Android-based application developed in this study utilizes a user-focused design approach, making it easier for Posyandu cadres to understand and use the application,

ultimately improving the effectiveness of nutritional status monitoring in children within the community(9).

Development Potential This application has the potential to be developed further with the addition of features such as growth trend analysis, personalized nutritional recommendations, and reminders for routine check-ups. This development will continue to be adapted to user needs and advances in nutritional science and information technology(25). This Android-based anthropometry application offers an innovative and practical solution for assessing the nutritional status of children aged 0-59 months. With a combination of ease of use, accuracy, and integration with health systems, this application has the potential to become an important tool in efforts to improve children's health and prevent nutritional problems in society. Effective implementation and continuous development will ensure this application provides maximum benefits to its users(26).

CONCLUSION AND RECOMMENDATION

This research succeeded in developing an innovative Android application for assessing the nutritional status of boys aged 0-59 months. This application has been proven to help Posyandu cadres increase the efficiency and effectiveness of service time . Apart from making anthropometric measurements easier, this application also provides faster and more accurate nutritional assessment results, which can be used as a basis for appropriate nutritional interventions for children.

Future research is recommended to expand the scope of use of this application to other age and gender groups, as well as test its effectiveness in various regions with different socioeconomic conditions. In addition, it is necessary to develop additional features that enable data integration with the national health system for more comprehensive monitoring of child nutrition.

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