

# The Accuracy Data of the Toddlers' Nutritional Status using the "PSG Balita" App

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## ABSTRACT

**OBJECTIVE:** This study aimed to determine the impact of the "PSG Balita" app on reporting toddlers' nutritional status.

**METHODOLOGY:** A quasi-experimental design study was conducted in 2022 in Aceh Province, Indonesia. The sample consisted of 123 health centre nutritionists responsible for monitoring the nutritional status of children under five years, selected through purposive sampling. Data were collected through interviews and observations using a questionnaire assessing timeliness, completeness, accuracy, and usefulness. The intervention involved a six-month training program using the "PSG Balita" application on the Android platform. Data analysis was performed using the Repeated Measures ANOVA test at a 95% confidence interval.

**RESULTS:** After implementing the application for six months, there was a significant increase ( $p < 0.05$ ) in the timeliness, completeness, accuracy, and usefulness of nutritional status data for toddlers. These results demonstrate that the "PSG Balita" application supports generating high-quality data on toddlers' nutritional status and enhances nutrition data reporting.

**CONCLUSION:** Utilizing the "PSG Balita" app has streamlined children's nutritional status tracking, ensuring high precision and early detection of malnutrition risks. Most importantly, it has improved the quality of nutritional status data.

**KEYWORDS:** Data Quality, Report, Timeliness, Completeness, Accuracy, Usefulness

## INTRODUCTION

Children's growth and development depend on proper nutrition, and malnutrition can harm people's health and way of life<sup>1,2</sup>. According to the World Health Organization (WHO), an estimated 149 million children under the age of five will experience stunting or chronic malnutrition by 2020. Indonesia has one of the highest rates of stunting in the world<sup>3</sup>. In 2018, 30.8% of children under five in Indonesia were affected by stunting, making it one of the countries with the highest stunting rates globally. The prevalence of stunting was 21.6% in 2022, wasting was 7.7%, underweight was 17.1%, and overweight was 3.5%. Nutritional challenges have persisted in Aceh Province, where stunting remains prevalent at 31.2%, the prevalence of wasting stands at 11.3%, underweight at 24.3%, and obesity at 1.9%<sup>5</sup>. It is imperative to address these challenges for the well-being of children everywhere.

Aceh Province has faced persistent difficulties addressing the three most prevalent nutritional concerns among children under five. From 2013 to 2022, Aceh Province consistently ranked among the top five regions in Indonesia with the highest prevalence of malnutrition. Both central and local administrations and the community are deeply concerned about the malnutrition issue in Indonesia, particularly in Aceh Province. Various initiatives have been launched, prioritizing regions for addressing nutrition issues and implementing expedited approaches to reduce them. One such initiative involves utilizing information and communication technology (ICT) in the health sector. The use of ICT is expected to enhance the quality of healthcare services and increase public access to accurate and trustworthy health information<sup>6</sup>. An Android platform application for monitoring growth, development, and assessing nutritional status is an example of ICT implementation in the health sector<sup>7-9</sup>.

Despite these efforts, malnutrition in Indonesia remains unresolved. Thus, additional research is required to assess the effectiveness of the "PSG Balita" application in improving the quality of nutritional status data for children under five years of age. Several studies have explored the impact of ICT-based health applications on healthcare effectiveness. Raymond L et al.<sup>10</sup> demonstrated that health applications can enhance the efficiency and quality of healthcare services. To enhance the performance of the nutritional status monitoring and reporting

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information system, developing a computer-based system is necessary, enabling quicker data collection and presentation in the form of food and nutrition coverage indicators<sup>11</sup>.

In previous research, a mobile application called "PSG Balita" was developed for the Android platform. The "PSG Balita" application was created using the Waterfall Models method and Android Studio, showing high suitability and acceptability among nutritionists. Implementing this system may assist nutritionists working at healthcare facilities in streamlining data reporting processes, especially regarding the nutritional status of young children, as indicated by metrics such as WHZ, HAZ, WAZ, and BAZ<sup>9</sup>. According to the ISO/IEC 25010 standard for quality assessment, the "PSG Balita" application demonstrated functional capability in meeting the requirements of nutrition experts (82.5%). Functional appropriateness, accuracy, suitability, and reliability of the application were evaluated, resulting in a score of 78%<sup>12</sup>.

The PSG Balita application has the potential to revolutionize the monitoring of nutritional status among children under five, offering efficiency, accuracy, and improved decision-making in public health. However, its success will depend on usability, acceptance by health professionals and communities, and ongoing support and maintenance. Regular evaluation and feedback mechanisms should be in place to ensure the continuous improvement of the application's functionality and impact.

Furthermore, this application aims to assist nutritionists and policymakers in monitoring nutrition issues in their respective areas, enabling appropriate decision-making for the target population. Therefore, in light of the problems described above, this study aimed to assess the impact of the "PSG Balita" application on reporting nutritional status data for children under five in Aceh Province, Indonesia.

**METHODOLOGY**

*Study Design*

This study employed a quasi-experimental design with

a pretest-posttest one-group design approach, which measured variables within the same group before and after the intervention. This design was chosen to foster cooperation and acceptance among the participants and nutritionists, making it more appealing to nutritionists as it involved collaboration and active participation in the intervention. Additionally, this design allowed for longitudinal observations, enabling the study of changes over time. This approach aligned to monitor the nutritional status of children under five for six months using the "PSG Balita" app. As a result, this study provides valuable insights into the impact of using the "PSG Balita" app on the accuracy and quality of nutritional status data for children under five. The study was conducted in Aceh Province over five months, from May to September 2022.

*Population and Sample*

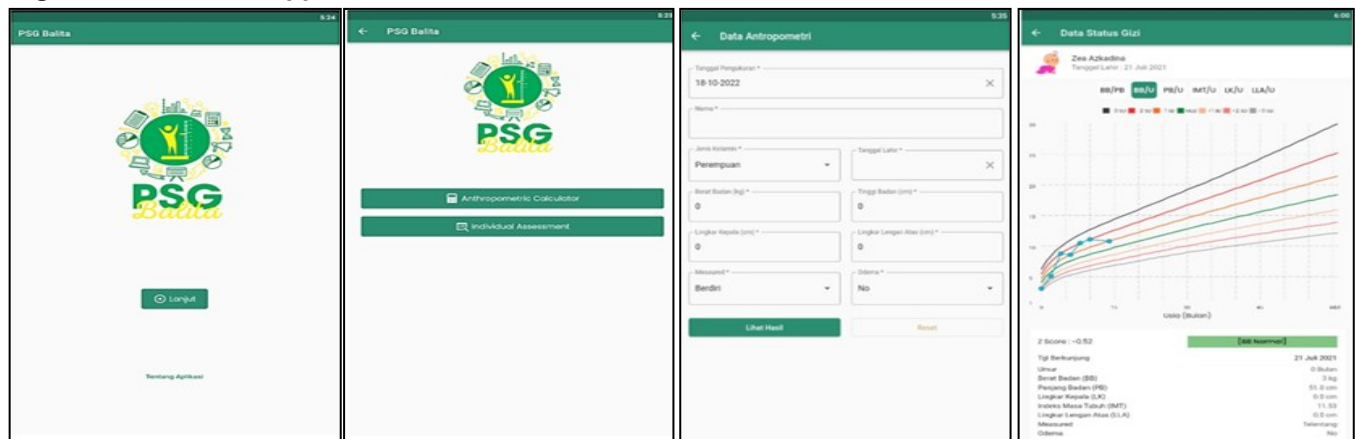
The study sample consisted of 123 health centre nutritionists responsible for monitoring the nutritional status of children aged 0-60 months for six months. The sample size was determined using the following equation for hypothesis testing for a population mean (two-sided test)<sup>13</sup>:

Sampling was accomplished through purposive sampling, with subjects selected based on specific criteria relevant to the study. Nutritionists at the Health Center collected anthropometric measurements and observations, inputting their data into the application.

*Instrument*

Data collection involved interviews and observations, focusing on timeliness, completeness, accuracy, and usefulness. The data collection instrument was a questionnaire comprising 20 questions. Anthropometric data, including Height (in cm) and weight (in kg), were measured using stature and SAGA brand digital scales, respectively. Additionally, the collected data, including the child's name, date of birth, date of visit, weight (in kg), Height (in cm), measurements, and edema factor, were inputted into the "PSG Balita" application. The "PSG Balita" app is accessible on the Play Store, and its interface is displayed in **Figure I**.

**Figure I: PSG Balita App view**



### Data Analysis

The data analysis involved several stages, including data reduction, inference testing, data display, and conclusion. Statistical data analysis was conducted using the R statistics application. The data in this study exhibited a normal distribution ( $p > 0.05$ ), as determined by the Shapiro-Wilk test, and showed homogeneity of variance ( $p > 0.05$ ) based on the results of Mauchly's Test. Therefore, the appropriate statistical test is the Repeated-Measures ANOVA at a 95% confidence interval.

### Ethical Statement

This study received approval from the Health Research Ethics Commission at Poltekkes Kemenkes Aceh (approval number LB.02.03/014/2021).

## RESULTS

The "PSG Balita" application offers a feature that allows visitors to access the main page and test the application's features. However, a profile is required if visitors wish to utilize additional features, such as calculating child nutrition information during the visit (*Anthropometric Calculators*), analyzing Nutritional Status Survey data, and monitoring toddler growth (*Individual Assessments*). In this updated version, users can no longer register (*Create an Account*). This change is aimed at enhancing and broadening application accessibility.

Data processing in the "PSG Balita" application was achieved by integrating PHP and a MySQL database, as depicted in the Entity Relationship Diagram (ERD)<sup>14</sup>. An Entity Relationship Diagram (ERD) is a model that defines the relationships between data in a database by representing fundamental data objects and their interconnections. ERD visually represents the data structure and relationships using various symbols and notations<sup>15</sup>.

The algorithm design procedure involved using PHP to assist the system in problem-solving and computation; in algorithmic programming, the activity often involves defining program logic based on database conditions<sup>16</sup>. The first step was formulating a formula to calculate the nutritional status of toddlers for all indicators, utilizing the LMS method. This internationally recognized statistical method, known as "the LMS method," was employed to calculate reference values. This method incorporates three parameters: power (L), median (M), and coefficient of variation (S), calculated for each age group, assuming that the data at each age are typically distributed after applying the Box-Cox transformation<sup>17</sup>. The second step involved using the World Health Organization (WHO) reference standard for assessing the nutritional status of toddlers.

The nutritional status of the children was determined by converting each toddler's weight and Height into standard values (Z-scores) using the WHO-2005 anthropometric scale. The WHO reference standard,

and the LMS method were employed to calculate the nutritional status of toddlers for all indicators, utilizing the following formulas<sup>18,19</sup>.

$$Z_{ind} = \frac{[y/M(t)]^{L(t)} - 1}{S(t) \cdot L(t)}$$

Description of the equation:

$Z_{ind}$ : Represents the Z-score value for each indicator, including WAZ, HAZ, WHZ, BAZ, MUACAZ, and HCAZ.

y: Represents measurements of Weight (kg), Height (cm), and BMI (kg/m<sup>2</sup>).

M(t): Stands for the Absolute Median value at the WHO growth standard reference for Age (A), or Height (H) or BMI.

S(t): Stands for the Absolute Sigma value at the WHO growth standard reference for Age (A) or Height (H) or BMI.

L(t) stands for the absolute lambda value at the WHO growth standard reference for age (A), Height (H), or BMI.

The "PSG Balita" app incorporates system-generated categories and thresholds based on the Minister of Health Regulation No. 2 of 2020 regarding Child Anthropometric Standards. New categories and thresholds derived from the Multicenter Growth Reference Study (MGRS) study protocol by WHO have been included to assess nutritional status<sup>20</sup>.

### View of the "PSG Balita" App

The "PSG Balita" app presents the *Anthropometric Calculator* and *Individual Assessment* modules on its initial screen. Nutrition experts confirm that the app's development adheres to scientific methods and the regulations governing nutritional status monitoring in Indonesia. This information is readily available within the app.

Furthermore, the calculator menu interface provides fields to input anthropometric data for toddlers, including date of birth, date of visit, sex, measured position, presence of edema, weight in kilograms, Height in centimetres, Head Circumference, and Upper Arm Circumference in centimetres (MUAC). After entering complete and precise anthropometric data, the app utilizes six indicators to determine the nutritional status of toddlers: weight-for-age Z-score (WAZ), height-for-age Z-score (HAZ), weight-for-height Z-score (WHZ), BMI for Age Z-score (BAZ), HCAZ, and MUACAZ. All indicator data use the Indonesian vocabulary.

In response to feedback from a nutritionist, it was decided to display the child's nutritional status alongside each indicator within the calculator menu feature, aligned with Minister of Health Regulation No. 2 of 2020 regarding *Child Anthropometric Standards*. This additional information aims to make it easier for users, including the general public, to understand the nutritional status of their children.

The updated feature, the *Individual Assessment*

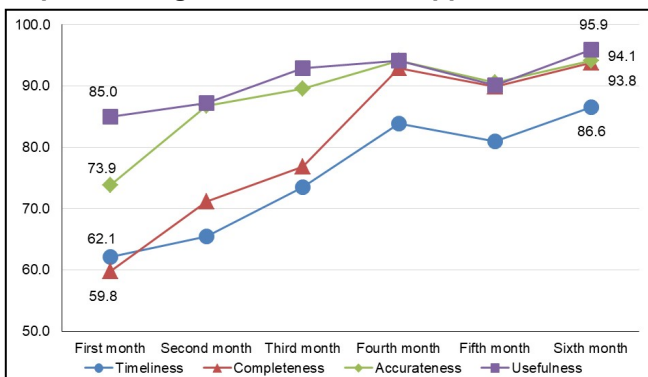
module, enables users to collect and maintain longitudinal data for repeatedly examined toddlers. This data includes anthropometric measurements. Integrating the Growth Module (*Individual Assessment*) empowers nutritionists to monitor nutritional status and identify growth issues in a more timely manner.

This module allows users to collect and retain longitudinal data for toddlers who regularly visit Integrated Healthcare facilities and receive growth charts. Anthropometric data on the toddlers are collected during these visits. The module's graphical representation enables the presentation of data across multiple visits, illustrating trends in children's growth. Nutritionists and caregivers can use this module to monitor children's development more effectively.

*Quality of Nutritional Status Data Reporting Using "PSG Balita"*

The study, conducted over six months at each health centre in Aceh Province, has significantly enhanced the quality of nutritional status data reports for children under five. The report quality is assessed based on indicators like timeliness, completeness, accuracy, and the usefulness of the data (**Figure II**).

**Figure II: Quality of Nutritional Status Data Reports Using the "PSG Balita" Application**



The results presented in **Figure II** demonstrate the positive impact of implementing the "PSG Balita" application on the quality of nutritional status data reports for children under five. There was a significant increase in timeliness from the 1st to the 6th month ( $p = 0.000$ ), with a mean difference of 24.5%; this indicates that implementing the "PSG Balita" application improved the timeliness of data collection for preparing nutritional status reports on toddlers.

Secondly, about completeness, there was a consistent, significant increase each month throughout the implementation period, culminating in a mean difference of 34.0% by the 6th month ( $p = 0.000$ ). The "PSG Balita" application notably enhanced the completeness of data related to the nutritional status of children under five, providing vital support for reporting in each health centre in Aceh

Province.

Thirdly, concerning accuracy, the statistical results indicated an average improvement of 20.2% from the 1st to the 6th month following the application's implementation. Thus, the "PSG Balita" application continued to significantly enhance the accuracy of reports on the nutritional status of children under five.

Fourth, an improvement was observed between the 1st and 6th month of implementing the "PSG Balita" application. It is worth noting that the increase in report quality in terms of usefulness was the smallest compared to the other parameters, at 10.9%. Nevertheless, this increase successfully enhanced the effectiveness of information collection related to the nutritional status of children under five for reporting ( $p = 0.002$ ).

In summary, the "PSG Balita" application positively impacted the quality of nutritional status data reports for children under five, particularly regarding timeliness, completeness, accuracy, and usefulness, in alignment with the research findings. This study demonstrates that nutrition workers at health centres utilizing the "PSG Balita" application can notably enhance the timeliness, completeness, accuracy, and usefulness of data reporting on the nutritional status of children under five; this aligns with previous research indicating how information technology can enhance the accuracy and efficiency of health data collection.

**DISCUSSION**

Plotting results on a growth chart can be used to detect growth disorders; however, due to rapid advancements in information technology, several applications can now detect growth disorders early<sup>21</sup>. Similarly, the module integrated into the "PSG Balita" app can identify infant growth disorders during each visit to Integrated Healthcare (Posyandu)<sup>22</sup>. Detecting growth disorders or the risk of overnutrition at an early stage allows for quicker and more effective preventive measures before a toddler's condition worsens<sup>23</sup>. Nutritionists and caregivers of young children<sup>24</sup> can utilize this functionality more effectively. While the "PSG Balita" app addresses domestic and community-level nutritional issues, it does not currently provide communication of infant growth analysis results<sup>9</sup>, indicating the importance of ongoing updates and development.

The Individual Assessment (IA) module is akin to an electronic Growth Chart that evaluates the growth and development of infants based on their age and gender. It allows for plotting the growth and development of children under five using five key indicators: WAZ, HAZ, WHZ, BAZ, MUACAZ, and HCAZ. The application operates offline, storing data on the Android smartphone's memory. WHO-2005 serves as the standard for presenting development charts.

### *Quality of Nutritional Status Data Reporting Using "PSG Balita"*

The study's results align with previous research, highlighting the capacity of information technology to enhance the integrity of health data<sup>25</sup>. Other studies have shown that information technology in the healthcare sector can enhance efficiency, accuracy, and user satisfaction<sup>26</sup>. Lwin MO et al.<sup>27</sup> found that using mobile applications for health data collection can improve data quality and work efficiency among health workers. Corsi DJ 2017<sup>28</sup> demonstrated that information technology can enhance data quality and reduce errors in acquiring nutrition data.

Implementing the "PSG Balita" application can also elevate the quality of nutritional status data for children under five by improving data management, reducing data entry errors, and expediting data analysis and reporting. Previous research has indicated that information technology in health data management can enhance data processing accuracy and speed<sup>26</sup>. Moreover, the application adheres to the ISO/IEC 25010 standard as a benchmark for measuring software quality. This standard encompasses various quality criteria, including functionality, dependability, security, and usability, ensuring that the "PSG Balita" application meets these established criteria.

However, it is essential to note that implementing information technology in health data management has challenges, including concerns about data security and privacy, a lack of information technology skills among health workers, and high implementation costs<sup>29</sup>. Using an ISO/IEC 25010-compliant "PSG Balita" application can help ensure that the data collected on the nutritional status of toddlers are accurate, comprehensive, and valuable for analysis and interventions by health professionals. This can significantly contribute to improving the quality of community-level child health services, a critical endeavour in Indonesia, given the prevalence of malnutrition, including stunting (21.6%), underweight (17.1%), and wasting (7.1%)<sup>5</sup>.

Health centre nutritionists must maximize their primary responsibilities and roles in community services. Therefore, training focused on information and technology should equip nutritionists at health centres with up-to-date knowledge of nutritional status monitoring applications. Such training can enhance their commitment and bring about cognitive changes<sup>24</sup>. The "PSG Balita" application can yield positive results, allowing for more precise and organized data acquisition. Moreover, this application facilitates the swift and efficient collection of information about the nutritional status of children under five. The application's data validation, clear data presentation, and the ability to enter data using a mobile camera contribute to reducing manual data entry errors during the collection process<sup>9</sup>.

This study had limitations regarding sample size and implementation duration. The subjects represented a single cohort in Banda Aceh, which indicates the nutritionists in Aceh Province. Additionally, as the application was implemented for only one month, nutritionists may need time to adapt to its use fully.

### **CONCLUSION**

After being implemented by nutritionists for six months, the "PSG Balita" application significantly improved the quality of under-five nutritional status data reports in Aceh Province. The aspects evaluated for report quality were timeliness, completeness, accuracy, and usefulness.

Promoting the "PSG Balita" application is recommended to enhance the quality of under-five nutritional status data in Aceh Province; this can be accomplished through the socialization and training of nutritionists and Posyandu cadres at the village level. Strengthening the monitoring and evaluation of the toddler nutritional status monitoring program across Aceh Province can help mitigate nutritional problems, including expediting the reduction of stunting.

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**Data Sharing Statement:** The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publically.

### **AUTHOR CONTRIBUTION**

Al Rahmad AH: Conducted research, from designing proposals to coordinating and conducting research, writing results and discussions, and compiling publication manuscripts.

Sofyan H: Played a role in helping design the "PSG Balita" application, ensuring that the application could function correctly and followed research needs. It also assists in the implementation and maintenance of applications during research.

Usman S: Responsible for data analysis involving collecting, processing, and interpreting research data. Contribution to compiling the analysis results and presenting the research findings.

Mudatsir: Assisted in corroborating the discussion and references in the research report. Additional insights and supporting arguments are provided during the research discussion. Compiled the reference list and ensured that the overall report had a solid theoretical basis

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