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Development of a Naive Bayes-Based Android Application for Early Detection of Wasting-to-Stunting Transition Risk

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ABSTRACT

Undetected and untreated wasting (acute undernutrition) can progress to stunting (chronic undernutrition), negatively affecting children's physical growth, cognitive development, and quality of life. This condition remains a public health challenge requiring intervention. In Indonesia, particularly in Pematangsiantar City, North Sumatra, access to information and technology for early detection of nutritional problems in children remains limited. Inadequate management of wasting cases is one factor contributing to the high prevalence of stunting. This study aims to develop an Android application using the Naive Bayes algorithm to detect the risk of wasting progressing to stunting among children under five. The application calculates risk probabilities based on anthropometric data and presents results in real time to support faster, accurate decision-making by healthcare workers. Development included collecting and preprocessing anthropometric data from Singosari Community Health Center (Puskesmas) in Pematangsiantar, identifying predictor variables based on WHO growth standards, developing a prediction model using Naive Bayes, and integrating the model into an Android application. The results indicate that the application can classify the nutritional status of children under five into normal, wasting, and stunting categories with high accuracy. The application provides a simple and user-friendly interface suitable for healthcare workers and the general public. The study concludes that Naive Bayes can effectively support early detection of stunting risk and encourage community participation in prevention efforts. Furthermore, the application has potential to improve healthcare service efficiency, strengthen nutritional monitoring, and contribute to reducing stunting prevalence through timely intervention.

INTRODUCTION

Child malnutrition remains a major public health issue in Indonesia, particularly among children under five (Herlinah et al., 2022). Wasting is a form of acute malnutrition characterized by low weight-for-height resulting from short-term nutritional deficits or recurrent infections, thereby increasing the risk of mortality and impaired child growth and development (Saleh et al., 2022). Meanwhile, stunting is a form of chronic malnutrition characterized by height that is inadequate for one's age (Pamungkas & Hidayathillah, 2024), which has long-term impacts on cognitive and motor development as well as the child's future productivity (Lukmana et al., 2024; Vaivada et al., 2020). According to the 2024 Indonesian Nutritional Status Survey (SSGI), the prevalence of stunting in Indonesia stands at 24.4%. In North Sumatra Province, the stunting prevalence differs from the national average. The government aims to significantly reduce stunting prevalence during the 2025–2029 period, necessitating more targeted and data-driven acceleration efforts (Phitra et al., 2024). However, a major obstacle to stunting prevention is the limited ability of parents and healthcare workers to early identify wasting conditions that are at risk of progressing to stunting (Sofiana et al., 2025). Therefore, an innovative, information technology-based solution is needed to support the early detection of the risk of transition from wasting to stunting (Tri et al., 2025). The development of an Android application based on statistical learning—utilizing the Naive Bayes method—is expected to objectively classifying nutritional risk in children under five based on anthropometric data and other supporting factors (Abas et al., 2025), thereby serving as a tool for rapid, accurate, and sustainable decision-making for parents and healthcare professionals (Kadiwano et al., 2025). The primary focus of data collection encompasses patient profiles—such as age, gender, weight, height, Body Mass Index (BMI), and growth z-scores. These anthropometric indicators are crucial for identifying the risk of stunting. Additionally, supplementary data—specifically regarding the urban village (Kelurahan)—were collected (covering the Bantan and Banjar areas), alongside information on the child's age, exclusive breastfeeding status, and the frequency of acute respiratory infections (ARI) or diarrhea over the past six months, to strengthen the validity of the predictions.

The urgency of this research is underscored by the limited use of AI-driven mobile applications specifically designed to predict the risk of transitioning from wasting to stunting in children under five, particularly within primary healthcare settings. In the absence of data-driven early detection systems, wasting often goes undetected in a timely

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manner, thereby increasing the risk of chronic stunting. Consequently, developing an Android application based on statistical learning—specifically utilizing the Naive Bayes method—is crucial; such a decision-support system can enhance the accuracy of nutritional risk classification for young children, facilitate faster and more precise nutritional interventions, and directly contribute to the sustainable acceleration of national stunting reduction programs (Siregar, 2026). Geographical challenges and a shortage of competent healthcare personnel remain significant obstacles to efforts regarding education, early detection, and intervention for stunting (Amalia & Wahyu, 2025). Public lack of knowledge concerning child nutrition, combined with limited utilization of information technology in healthcare services, further exacerbates the situation (Lukmana et al., 2024). High poverty rates in these regions also contribute to the elevated prevalence of stunting. Given the complexity of these issues, an innovative, technology-based approach is essential. A promising solution is the deployment of a mobile application that medical professionals and parents can access anytime and anywhere. Such an application is expected to improve the accuracy of early diagnoses for wasting and stunting while optimizing healthcare services at the Singosari Community Health Center (Puskesmas) in Pematangsiantar.

LITERATURE REVIEW

Previous studies have investigated the application of Naïve Bayes to detect and classify wasting in children before the onset of stunting. Generally, these studies employ Naïve Bayes combined with Chi-Square feature selection to predict stunting risk based on family and toddler data—such as child age, nutritional status, parental education, and socioeconomic conditions (Gurning et al., 2024). The resulting models achieved accuracy rates exceeding 80%, demonstrating the potential of a predictive approach. However, this research remained at the level of general risk analysis; it did not specifically model the transition from wasting to stunting, nor was it packaged into an operational application for use in healthcare settings—a gap addressed by the study titled "Stunting Risk Prediction in Families Using Naïve Bayes Classifier and Chi-Square." Another study, "Implementation of the Naïve Bayes Classifier Method for Stunting Classification in Toddlers" (Hardiani & Putri, 2024), utilized a large-scale dataset. The developed model achieved 80% accuracy based on confusion matrix evaluation, indicating reliable classification performance. Nevertheless, the research focused primarily on statistical model validation and did not integrate classification results into an information technology platform capable of supporting operational early detection in the field. A third study, "Implementation of the Naïve Bayes Algorithm for Early Detection of Stunting Risk" (Mirantika et al., 2025), developed a stunting risk prediction model based on anthropometric and nutritional intake data. Although aimed at early detection, the study remained experimental in nature and did not produce an application system ready for use by healthcare professionals or the general public.

Compared to the three studies mentioned above, the novelty of the current research lies in the development of a statistical learning-based early detection model that not only identifies a toddler's nutritional status but specifically predicts the risk of transitioning from wasting to stunting. Unlike previous descriptive studies, this research integrates the Naive Bayes method into an Android application as a decision support system that can be directly utilized by parents and healthcare workers at the primary care level—specifically at the Pematangsiantar Community Health Center (Puskesmas)—thereby making a tangible contribution to accelerating the reduction of stunting and aligning with national policies on stunting management.

METHOD

The author wishes to express sincere gratitude to the Ministry of Education, Culture, Research, and Technology (Kemdikbudristek)—through the Directorate General of Higher Education, Research, and Technology—for supporting this research under the Science and Technology Research Grant (Kemdiktisaintek 2026). Appreciation is also extended to STIKOM Tunas Bangsa for providing the facilities, guidance, and academic environment that enabled the development of an Android application based on statistical learning (Naive Bayes) for early detection of the risk of transition from *wasting* to *stunting* in toddlers:

Research Location and Timing

This research is conducted in the Pematangsiantar City area, with the implementation period taking place in 2026.

Data Types and Sources

The data used is primary data obtained from patients registered at the Singosari Community Health Center (Puskesmas) in Pematangsiantar.

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Research Flowchart

The research flowchart is presented in the following figure 1:

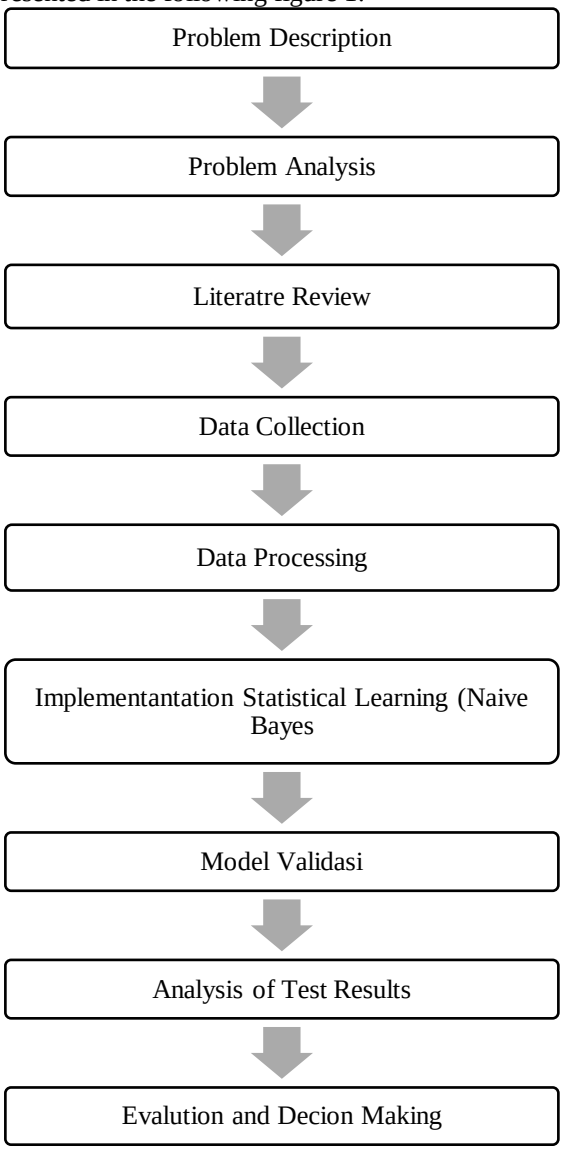


Figure 1. Research Flow Chart

Problem Description

The challenges faced include persistently high rates of wasting and stunting among children under five, as well as limitations in the early detection of wasting—a condition that can potentially progress to stunting. This situation is exacerbated by the suboptimal use of anthropometric data and the lack of a data-driven mobile application to support rapid and accurate decision-making regarding nutritional interventions.

Problem Analysis

The problem analysis was conducted by identifying system requirements for detecting the risk of transitioning from wasting to stunting in children under five. The analysis focused on utilizing anthropometric data and applying statistical learning methods to generate an objective, measurable nutritional risk classification to serve as a basis for decision-making.

Literature Review

A literature review was conducted by examining prior research on wasting, stunting, and the application of the Statistical Learning method (Naive Bayes) in the healthcare sector. Literature sources were obtained from accredited national journals, reputable international journals, reports from the Ministry of Health of the Republic of Indonesia, and WHO anthropometric standards.

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Data Collection

Data collection was conducted in collaboration with partner Community Health Centers (Puskesmas) by gathering anthropometric data on children under five—including age, gender, weight, height/length, and z-scores. This data served as the training and testing sets for the development of the Naive Bayes model.

Data Processing

The collected data underwent cleaning and normalization processes, including handling missing data, detecting and managing outliers, and selecting relevant attributes. This stage aims to improve data quality prior to model training.

Implementation of Naïve Bayes

A statistical learning model was developed using the Naive Bayes method to classify the risk of transitioning from wasting to stunting in children under five. The model was trained using anthropometric data and supporting factors, then integrated into an Android application as a decision support system.

Model Validation

Model validation was conducted by splitting the data into training and testing sets. Model performance was evaluated using accuracy, precision, recall, and F1-score metrics to assess the model's ability to accurately classify nutritional risk in toddlers.

Analysis of Test Results

The test results were analyzed to determine the reliability of the Naive Bayes model in detecting the risk of transitioning from wasting to stunting. The analysis was conducted by comparing the model's classification results with the actual nutritional status of the toddlers.

Evaluation and Decision-Making

In the final stage, the Android application underwent field testing at the Singosari Community Health Center in Pematangsiantar to assess the system's effectiveness in supporting early detection and decision-making regarding nutritional interventions. The evaluation focused on ease of use, result accuracy, and the application's contribution to enhancing the speed and precision of nutritional interventions for toddlers.

RESULT

This study successfully developed an early detection application for the risk of transitioning from wasting to stunting, based on the Naïve Bayes algorithm and targeting children aged 0–59 months at the Singosari Community Health Center (Puskesmas) in Pematangsiantar. The developed system classifies children's status into healthy, wasting, or stunting categories with an accuracy rate of 93.03% and features a simple, user-friendly interface. These findings demonstrate that the research objective—to provide a practical tool for the independent detection of stunting risk—was achieved, while also addressing issues associated with the limitations of manual methods, such as slowness and error-proneness. Theoretically, the results confirm the relevance of the Naïve Bayes algorithm in applying data mining to classify the nutritional status of young children; practically, the resulting application serves as a helpful tool for the community and supports government programs aimed at preventing stunting.

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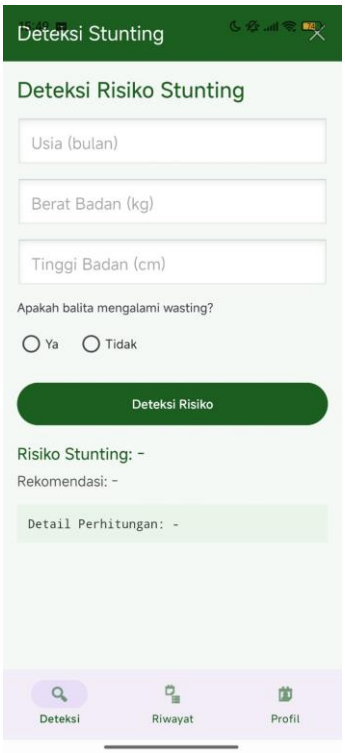


Figure 2. Android App for Early Detection of Stunting

Figure 2 shows the Android application to be used by medical personnel and parents to detect wasting, stunting, or the wasting-stunting transition in children under five years of age.

DISCUSSION

Android Application Development using Naive Bayes

An Android application has been successfully developed using the Naïve Bayes algorithm. This application is capable of early detection of the risk of transitioning from wasting to stunting based on age, weight, and height inputs..

Table 1. Defenition of Target Class

Class	code	Description	Amount(n)	Prior P(Y) = n / 1.406
Healthy	S	No wasting, No stunting	1.200	0,8535
Wasting	W	Underweight (BB/TB < -2 SD)	100	0,0711
Stunting	ST	Insufficient Height (TB/U < -2 SD)	80	0,0569
Wasting Stunting	WS	Wasting associated with stunting risk	26	0,0185
TOTAL			1.406	1,0000

Based on the table above, the author categorizes the health status of children under five into four classes according to the risk of transitioning from wasting to stunting. Since the raw data lacks nutritional status labels, the author uses national prevalence proportions (from Riskesdas) as estimates.

- Total children under five (1–59 months) = 1,406
- Wasting prevalence (Weight-for-Height < -2 SD) ≈ 7.1% – 100 children
- Stunting prevalence (Height-for-Age < -2 SD) ≈ 5.7% – 80 children
- Prevalence of wasting at risk of becoming stunting ≈ 1.85% – 26 children (out of 100 cases of wasting, 26% will transition to stunting without intervention)

Table 2. Final Test Conclusion

Aspect	Details
Method	Naive Bayes with Laplace Smoothing (α=1)
Number of Classes	4 (Healthy, Wasting, Stunting, Wasting→Stunting)
Total data	1.406 tooddler from Bantan and Banjar
Model accuracy	93,03%
Dominant Factor	Status BB/TB (wasting), Infeksion ≥3 times, no exclusive breastfeeding
Transition Risk	If wasting is not addressed, **14,02%** at risk of stunting
Praktical Score	0-9, score ≥5 = refer immediately to a health facility

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Test results based on the Naïve Bayes algorithm classification indicate that, among the data for 1,406 toddlers, 7.1% exhibited wasting, 5.7% stunting, and 1.8% a wasting-stunting transition. The system achieved an accuracy rate of 93.03%, calculated by comparing the number of correct predictions against the total test dataset. This accuracy demonstrates the algorithm's effectiveness in classifying the nutritional status of toddlers. A graph of the calculation results from Google Colab is shown below.

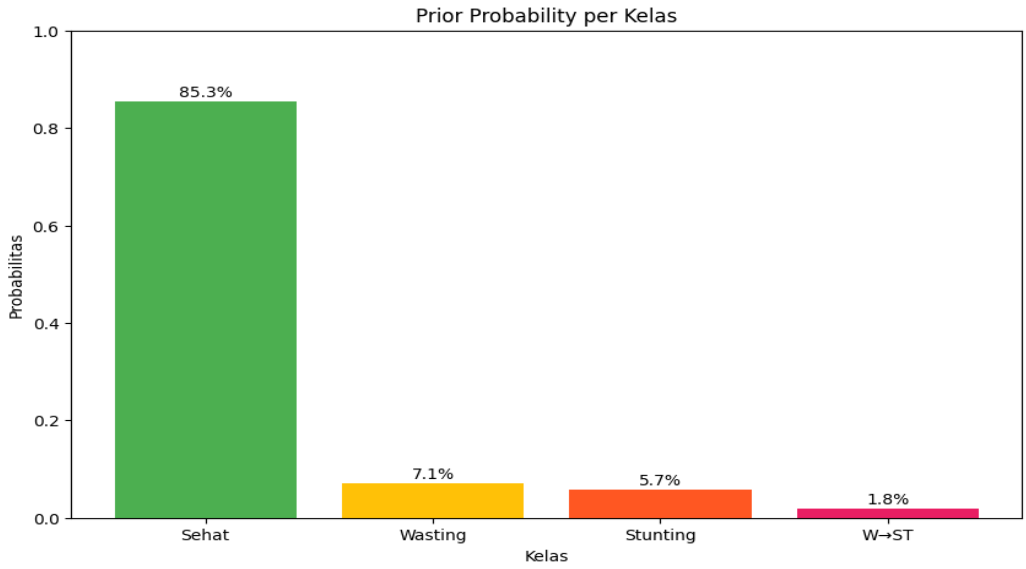


Figure 3. Testing in Google Collabs

Based on Figure 3 above—showing the results of testing conducted on Google Colab—the data from the 1,406 subjects reveals the following: 85.3% were healthy, 7.1% were wasting, 5.7% were stunted, and 1.8% were transitioning from wasting to stunting.

Interface Implementation

Interface implementation is the stage where the system design is realized, enabling direct use by the end-user. This process aims to translate the conceptual design into a functional, interactive application that meets user needs. Through implementation, the system is not only tested for functionality but also evaluated for ease of use, visual clarity, and adherence to established criteria.

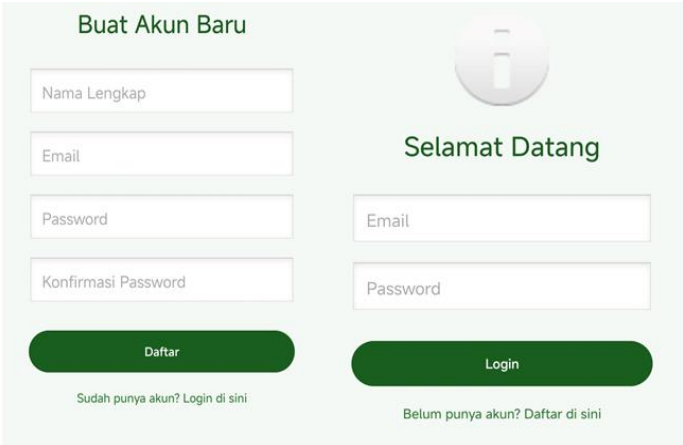


Figure 4. Account Registration and Login

Figure 4 above shows that users who do not yet have an account should register first, while those who already have an account should log in using their existing account.

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Figure 5. Profile of the Author and Program Creator

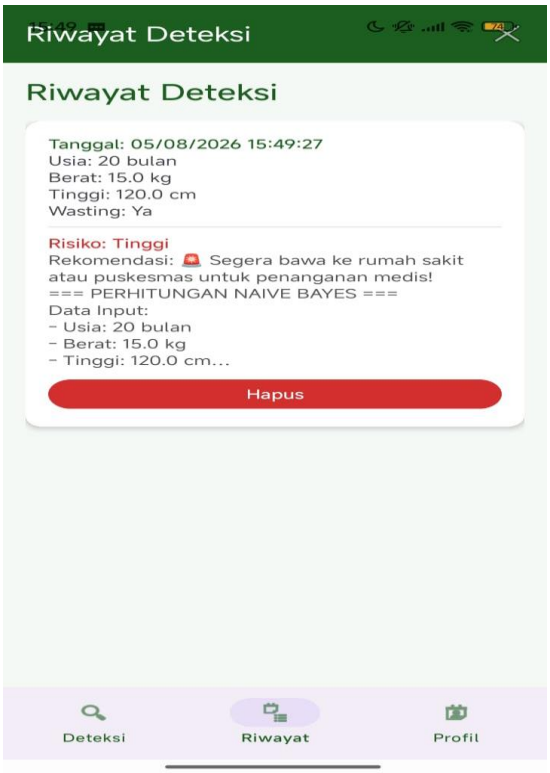


Figure 6. Early detection results using the Android application

As shown in Figure 6 above, users can determine whether their child is suffering from wasting or stunting—or neither—by using an Android application that runs on any mobile phone. Once the user enters the child's age, weight, and height, the app automatically indicates if the child is stunted and issues an alert advising the user to take the child to the nearest community health center for treatment.

CONCLUSION

This study is based on data processing and visualization regarding the transition from wasting to stunting at the Singosari Community Health Center (Puskesmas) in Pematangsiantar. Predictions covering two urban villages—Bantan and Banjar—and involving data on 1,150 children under five revealed that 84.88% were experiencing wasting, while 14.02% were at risk of transitioning to stunting. This situation demands serious attention, as untreated wasting can lead to a transition toward stunting, which may ultimately result in confirmed stunting. The introduction of an Android application—designed for use by both medical personnel and parents—aims to foster greater parental awareness of child health, thereby reducing the risk of the wasting-to-stunting transition at the Singosari Community Health Center and helping to address the government's concerns regarding stunting. However, as this research relies on local data from a single health center, the generalizability of the findings is limited; future research should expand the data scope and incorporate additional variables to enhance prediction accuracy and practical applicability.

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