

CHAPTER I

INTRODUCTION

1.1 Background Of The Study

Nutrition is an essential dietary substance required to support an individual's development, growth, and overall health [1]. Nutritional balance refers to a daily dietary composition that contains a variety of foods in quantities appropriate for the body's needs, tailored to factors such as height, weight, gender, and age. Poor dietary patterns or an unbalanced nutritional intake can lead to nutritional deficiencies, resulting in relatively lower weight and height. Conversely, overnutrition (obesity) is also a potential risk that may occur.

During childhood, specifically within the age range of 6 to 12 years, children undergo school-age growth characterized by the stabilization of physical growth, such as increases in height and weight. This period also involves a significant acceleration in cognitive and social development, where children begin to think logically, exhibit advanced complex language skills, and develop moral values alongside more mature emotional management. Furthermore, children start to show early signs of puberty between the ages of 10 and 12 years (pre-adolescence). Dietary habits during this phase generally require close monitoring to prevent the development of excessive eating habits outside of main meal times. Excess weight has now become a significant challenge in children. Overweight status can be measured using the standard deviation score (z-score). Excessive weight is one of the primary factors contributing to the onset of degenerative diseases, such as obesity and type 2 diabetes, in adulthood. Conversely, malnutrition can also lead to impaired cognitive and motor development in children [2].

Nutritional status reflects how the body achieves a point of balance between meeting daily energy and nutrient requirements and the actual dietary intake consumed daily, which can be measured through its physical impact. Furthermore, nutritional status serves as an indicator of the adequacy of daily food provision and reflects body equilibrium. The nutritional status of children is a crucial aspect that demands deeper attention, as it has a significant impact on their growth and development into adulthood. Behind the complex influences of health aspects, knowledge levels, economic conditions, as well as environmental and cultural factors, an individual's nutritional status profile remains inseparable from the dynamics of their energy and

protein consumption patterns [3]. Poor nutritional status will adversely affect physical growth, mental development, and cognitive processes, which subsequently impacts productivity and work capacity in adulthood. [4].

Data recorded in the Indonesian Health Survey (2023) indicates that the issue of overweight and obesity has shadowed children since primary school age (6–12 years) at a rate of 19.7%, and this condition becomes increasingly concerning in the adolescent phase (13–15 years), which records an incidence rate of 16.2%. The challenge of malnutrition also shows a worrying trend; this is reflected in the wasting rate (low weight-for-height) reaching 7.7%, and the underweight rate (low weight-for-age) standing at a percentage of 17.1%. In the field of informatics, determining a classification method appropriate for the object of child nutrition is critical to achieving accurate results in identifying the nutritional status of children. Among the methods utilized are Gradient Boosting Machines (GBM) and Extreme Learning Machine (ELM). GBM is a decision-tree-based supervised learning method applied for classification tasks. This algorithm operates sequentially, wherein each added predictor corrects the errors made by the preceding predictor [5]. The Extreme Learning Machine (ELM) algorithm, as a novel approach, emerged from the evolution of the fundamental concepts of Artificial Neural Networks (ANN). ELM is a variant of feedforward neural networks that features a single hidden layer, commonly referred to as Single Hidden Layer Feedforward Networks (SLFNs) (Prianda & Widodo, 2021). The ELM method offers significant advantages through its more adaptive design and lower complexity, which in turn accelerates the resolution process for regression and data projection problems.

The Gradient Boosting Machine (GBM) is one of the most frequently used and popular machine learning algorithms for classification and regression tasks, renowned for its high accuracy and overall effectiveness [7]. Several previous studies employing the Gradient Boosting Machine (GBM) method were conducted by (Sari & Prabowo, 2025). Entitled “Comparative Analysis of House Price Prediction Using Random Forest, Gradient Boosting, and XGBoost,” the study conducted by Sari and Prabowo attempted a comparative analysis of house price prediction in the Yogyakarta region, involving features such as land and building area. The performance results presented using GBM demonstrated good execution, achieving a Coefficient of Determination

(R^2) of 0,7639. This R^2 value indicates that the GBM model is capable of explaining 76.39% of the variation in house prices.

The Extreme Learning Machine (ELM) is a highly renowned method in the field due to its focus on training speed. Several previous studies employing the Extreme Learning Machine (ELM) approach were conducted by Jannah [9]. The objective of the study conducted by Jannah. was to assess and classify water samples based on various substance parameters that determine whether the water is potable or non-potable. The evaluation of the ELM model demonstrated superior performance in predicting water quality labels, yielding a remarkably high classification accuracy rate of 97.873%. The advantage of ELM, besides its accuracy, lies in its extreme learning speed compared to traditional neural network methods, making it a highly efficient model for data classification.

Based on the research presented by Jannah, as well as Sari and Prabowo above, the distinguishing factor of the current study is the comparative analysis of speed and accuracy between a fast Neural Network model (ELM) and a robust Ensemble Boosting model (GBM) applied to child nutrition classification. Furthermore, while other studies have typically utilized only one of these models (either GBM or ELM exclusively) or compared GBM with other ensemble methods (such as Random Forest or XGBoost), this research sets itself apart by addressing the double burden of malnutrition within a single multi-class classification model. Furthermore, this study was conducted at the H.M. Mawardi Al-Islam Hospital in Krian, ensuring that the generated data is validated and highly relevant for machine learning model classification.

Here is the formal academic translation suitable for your undergraduate thesis:

The primary objective of conducting this research is to support efforts in addressing child malnutrition in Indonesia through a fast, accurate, and machine learning-based approach that minimizes human error. Furthermore, considering the geographic context of Northern Surabaya, a region characterized by a significant number of children whose nutritional status has not yet met the established standards, this study gains further urgency. Against this backdrop, the researcher intends to conduct a study comparing the performance efficiency of the Extreme Learning Machine (ELM) and Gradient Boosting Machine (GBM) models to determine the most effective method for classifying the nutritional status of children aged 6 to 12 years. This comparative

evaluation will be measured using four metric evaluation parameters (accuracy, precision, recall, dan F1-score) utilizing data from the H.M. Mawardi Al-Islam Hospital in Krian.

1.2 Problem Statement

The specific research questions that serve as the primary focus of this study are formulated as follows:

1. How are the Gradient Boosting Machine (GBM) and Extreme Learning Machine (ELM) classification models designed and implemented to evaluate the nutritional status of children at the H.M. Mawardi Al-Islam Hospital in Krian?
2. How do the performance metrics of the Gradient Boosting Machine (GBM) and Extreme Learning Machine (ELM) models compare in classifying the nutritional status of children at the H.M. Mawardi Al-Islam Hospital in Krian?

1.3 Research Objectives

The objectives of this research are formulated as follows:

1. To design the Gradient Boosting Machine (GBM) and Extreme Learning Machine (ELM) models for classifying the nutritional status of children at the H.M. Mawardi Al-Islam Hospital in Krian.
2. To analyze the evaluation results of the Gradient Boosting Machine (GBM) and Extreme Learning Machine (ELM) methods for child nutritional status classification in terms of evaluation metrics (accuracy, precision, recall, and F1-score).

1.4 Significance of the Study

The benefits derived from this study, titled "Comparative Performance Analysis of Child Nutritional Status Classification Models at the H.M. Mawardi Al-Islam Hospital in Krian," are as follows:

A. Benefits for the Researcher

1. To provide a model that can effectively and accurately assist in classifying the nutritional status of children at the H.M. Mawardi Al-Islam Hospital in Krian.

2. To contribute to the development of data classification techniques in the field of public health, particularly regarding the monitoring of child nutritional status.
3. To enhance the researcher's experience in conducting community-based research on child nutrition at the H.M. Mawardi Al-Islam Hospital in Krian

B. Benefits for Lecturers / Faculty Members

1. To serve as an additional reference in the application of machine learning to healthcare issues, specifically regarding child nutritional status.
2. To enrich instructional materials, particularly for courses related to data mining, machine learning, or applied statistics.
3. To serve as a source of inspiration for the development of future research topics in the field of healthcare data analysis.

C. Benefits for Students

1. To broaden insight and understanding regarding the application of machine learning methods in healthcare data analysis.
2. To serve as a baseline reference or citation for the preparation of final undergraduate theses.
3. To assist students in developing skills in data analysis, predictive modeling, and the selection of appropriate methodologies for research in the fields of data mining and healthcare.

1.5 Scope and Limitations

1. Data Limitations

The research data is strictly limited to medical records of children aged 6 to 12 years obtained from the H.M. Mawardi Al-Islam Hospital in Krian, spanning from September 2025 to February 2026. The features utilized include name, weight, height, age, gender, and Body Mass Index (BMI).

2. Methodological Limitations

The performance comparison is exclusively conducted between two methods: Extreme Learning Machine (ELM) and Gradient Boosting Machine (GBM).

3. Output and Implementation Limitations

This study is limited to the performance analysis of models for classifying child nutritional status (adequate and inadequate) based on specific features (weight, height, age, gender, and BMI) at the H.M. Mawardi Al-Islam Hospital in Krian.