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Early Detection and Recommendation of Anemia in Adolescent Females Using Artificial Intelligence

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ABSTRACT

Background: The usual detection of anemia is checking by hemoglobin (Hb) levels. But the process requires quite a lot of preparation and implementation stages so the adolescent can not do it independently, in real-time, and anywhere. Therefore, an early detection system for anemia in adolescent females was developed using artificial intelligence. Where in the system will display the results of anemia detection based on signs, symptoms and risk factors as well as recommendations for anemia prevention.
Purposes: Innovate early detection systems and recommendations for anemia in adolescent females using artificial intelligence based on system accuracy values.
Methods: The method in this research is the research and development method. Using 430 data on signs of symptoms, risk factors, and Hb examination results for adolescent females to build a detection and recommendations system.
Results: Based on 4 algorithm tests, the highest system accuracy value is 81.3% using K-nearest neighbors (KNN) and the recommendation accuracy is 90.9%.
Conclusion: The study is proven to be able to build an anemia detection system using artificial intelligence K-Nearest Neighbor with the result of a system accuracy rate of 81,3%, and the recommendation system for anemia uses artificial intelligence forward chaining method with the results of a system accuracy rate of 90,9%.

Keywords: early detection, anemia, adolescent females, artificial intelligence**.**

INTRODUCTION

Based on data Riskesdas 2018, it was found that 23% or around 4.8 million out of 21 million adolescent females in Indonesia had anemia, most of which was caused by a lack of iron.[1] The World Health Organization (WHO) has a target in 2025 to reduce anemia by (50%) in adolescent females. Recognizing the signs and symptoms of anemia can be used as one way to prevent anemia which will be followed up with a diagnosis of anemia examination to health workers.[1] Currently, the detection of anemia is done by blood tests using an invasive Hemoglobin (Hb meter) device. This method is injurious and requires time for sample checking preparation. Not everyone can carry out these examinations independently and flexibly.[2] Based on the results of the preliminary research, not all schools or health centers can carry out Hb checks, so if adolescent females have symptoms of anemia, they assume that this will go away on its own.[3],[4]

The use of Artificial Intelligence in the detection of a disease is already familiar, such as digital images of eyes to determine hemoglobin levels, the use of expert systems in the detection of anemia, and the use of Bayes' theory in detecting anemia[5][6][7]. Based on previous research, technology has been used in the early detection of anemia, but the results obtained are still limited to detection results and have not yet reached the recommendation stage.

Data on smartphone usage in Indonesia in 2021 reached 89% or 167 million people.[8] The advantages of smartphones are very complex, starting from being used for communication, storing important documents, and entertainment, Not a few users of this smartphone operate for learning media or memory media.[9] Using mobile applications to detect anemia can make it easier for young women to do it independently at home[10] The use of smartphones in detecting possible anemia is assisted by artificial intelligence (AI). Artificial intelligence or artificial intelligence is a type of technology that can imitate human intelligence to make human life easier.[11] he use of artificial intelligence in detecting a disease requires techniques in compiling a database system that will be tested through an algorithmic system.[12]

This study will develop an anemia early detection system based on signs, symptoms, and risk factors to be able to provide a recommendation based on the detection results. The recommendation guidelines provided will be adjusted to anemia prevention guidelines and nutritional coverage guidelines[13]. It is hoped that the results of this study can increase adolescent awareness of anemia in an easy way, inexpensive and can be done independently, so that they are able to become qualified and healthy prospective pregnant women.

METHODS

This research is Research and Development (R&D). This research has received permission from the ethic commission from Ministry of Health of Semarang Ministry of Health No. 0553/EA/KEPK/2022 on June 15, 2022. In The study goal was to design a system for anemia detection with recommendations, then test the success of the system, and account for it so that it can be used for adolescent girls or assist health services. The population in this study is all adolescent girls who attend school in Cirebon Regency, West Java Province. The Sampel in this study used data on adolescent girls who experience symptoms of anemia or who do not experience symptoms and risk factors for anemia are included with hemoglobin level values. The data obtained was 430 data by distributing questionnaires on signs of anemia symptoms and risk factors for anemia as well as hemoglobin level values in the form of a Google form to Junior high school (SMP) 1 Babakan, Senior high school (SMA) 1 Babakan, SMP 1 Sumber, and SMA 1 Sumber.

The instruments used in this study were: interview guidelines used to collect the necessary data, expert feasibility test assessment questionnaires used so that the assessments given by IT experts, doctors, and nutrition experts were regular and in accordance with system conditions, and a system framework consisting of a framework for the anemia detection system and recommendations. To determine the level of accuracy of the anemia detection system and recommendation system it was necessary to test the accuracy of the system by calculating the percentage of truth. the accuracy of the system detection used 4 algorithms K-nearest neighbor, Naive Bayes, Random forest, and decision tree. Of the 4 types of algorithms, one will be selected with the highest accuracy value. The accuracy of the recommendation system is assessed based on the percent correctness in providing recommendations using the forward chaining method.

RESULTS

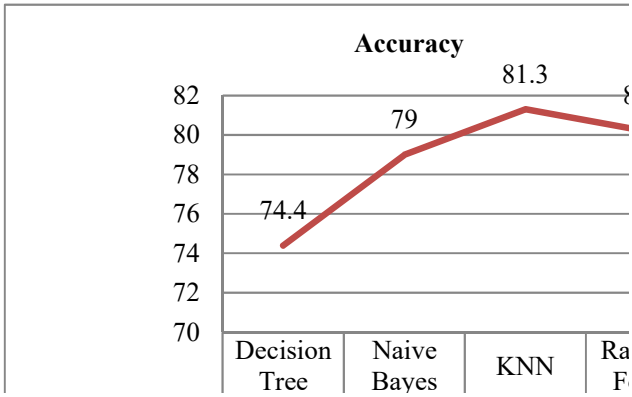


Fig 1: Results Accuracy System Detection

After building a system with 80% of the data or 344 main data sets used as training data, trials were carried out using 20% or 86 of the data used for data testing. Based on Figure 1, the test results on the four algorithms used show that the K-nearest neighbor (KNN) is the algorithm with the highest level of accuracy. Decision tree with an accuracy value of 74.4, naïve Bayes with an accuracy value of 79, and random forest with an accuracy value of 80.2.

Table 1: Results Accuracy Recommendation

No.	Accuracy	Average accuracy score
1.	Recommendation for anemia	90,9%

From Table 1 above, it can be concluded that based on the results of the recommendation of anemia using forward chaining methods it has a score of 90.9%. The conclusion was that the artificial intelligence of forward chaining methods was accurate in providing recommendations for anemia.

DISCUSSION

Accuracy system Detection

Screening is a method to know disease is unknown with early detection[14] This research is different from other research that has made innovations related to the early detection of anemia by identifying the type of anemia from several laboratory examination results.[5] In this study, detection was carried out by looking at signs of anomalies, symptoms, and risk factors for anemia.

Prevention of anemia in adolescent females is carried out in preparation for becoming a healthy pregnant woman in order to minimize the incidence of LBW, premature birth, and bleeding.[15] Pregnant women will experience hemodilution and are susceptible to anemia.[16] Even though the government has implemented a consumption blood booster medication program (TTD) and routinely checks Hb for pregnant women, in fact, this movement has not been able to reduce the incidence of anemia in pregnant women.[17] Therefore, the TTD program is aimed at adolescent females and women of childbearing age. The program is based on the emergence of nutritional problems in children under two years of age which are closely related to the readiness of a woman's health and nutrition to become a mother, including adolescent females.[18]

Detecting anemia can be done by checking Hb, but few teenagers have the opportunity to have their Hb levels checked. The reason is fear of needles and ignorance of information about health, so they think that checking Hb or consumption of blood booster medician (TTD) is not important.[19] Early detection of anemia can be done by recognizing the signs, symptoms, and risk factors for anemia in adolescent girls.[20], [21]

In this research, the development of an artificial intelligence in the form of machine learning is carried out which can learn on its own through the data provided to decide on a prediction of the risk of anemia in young women. Machine Learning is made to detect early signs, symptoms, and risk factors for adolescent girls.

The artificial intelligence method used in this research is machine learning (ML). ML uses four algorithms namely KNN, Random Forest, Decision Tree, and Naïve Bayes where the KNN algorithm has the highest accuracy rate of 81.3%. The results of this research are in line with the study to produce an anemia diagnosis system based on digital image processing of the conjunctiva of the eyes, tongue, palms, and nails with an accuracy of 71.25% using the KNN algorithm.[22] K-Nearest Neighbor (K-NN) is a method that uses a supervised algorithm where the results of the new query instances are classified based on the majority of categories in the KNN. The working principle of KNN is to find the shortest distance between the data to be evaluated with k neighbors (neighbors) in the training data.[23] he concluded that the anemia detection system for adolescent females obtains a high accuracy value of 81.3% based on the KNN algorithm.

Accuracy recommendations anemia

The results of anemia detection will conclude whether the adolescent females are predicted to experience anemia, which will then be given a recommendation/suggestion for anemia prevention. One of the recommendations is taking iron tablets, from this suggestion it is hoped that youth awareness about anemia will be achieved and provide opportunities to get detection services independently and easily. This goal is in accordance with the World Health Organization (WHO) target in 2025 to be able to reduce anemia by (50%) in adolescent females.[26]

The accuracy of the recommendations obtained a value of 90.9% using the forward chaining method. The same results were obtained in the Friska 2020 research with an accuracy value of 89% for the stunting detection and recommendation system in pregnant women.[24] Forward chaining is one of the reasoning methods used in inference engines. The logic used is forward flow so this method can work very well in drawing conclusions from a problem. This method will process recommendations that start from various facts and information on signs, symptoms, and risk factors for anemia.[25]

CONCLUSION

The study is proven to be able to build an anemia detection system using artificial intelligence K-Nearest Neighbor with the result of a system accuracy rate of 81,3%, and the recommendation system for anemia uses artificial intelligence forward chaining method with the results of a system accuracy rate of 90,9%.

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