Vitamin D and B12 Deficiency Detection using Machine Learning Techniques

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Abstract - Nowadays millions of people in the world suffer from vitamin deficiency which underlines health issues in people's daily lives. Health issues due to vitamin deficiency are on the rise now due to failure to acquire necessary vital minerals and nutrition due to lack of awareness of type of deficiency they may undergo without medical consultation. Early identification of vitamin deficiencies helps to avoid serious causes such as anemia, infectious disease-related deaths, and pregnancy and childbirth-related deaths. Due to advancement in technologies, there are numerous techniques used for the early detection of vitamin deficiency. This study proposes a novel approach for detecting vitamin D and B12 deficiencies using a Machine Learning algorithm. Using the collected blood reports and incorporating symptoms correlated with the deficiencies, algorithm that is Support Vector Machine(SVM) algorithm is employed and provides a user-friendly chatbot to facilitate self-assessment for individuals, offering personalized recommendations without any medical consultation. These recommendations not only include early detection alerts but also prescriptions for required foods and preventative measures, aligning with medical guidelines for proactive healthcare.

Index Terms - Vitamin D and B12 Deficiency, Machine Learning, Blood reports, Recommendations

I. Introduction

The global health issue which is affecting millions of people worldwide and needs its attention is Vitamin Deficiency detection in its early stages. According to WHO (World Health Organization) every kid, woman, and man is lacking in getting a balanced diet due to lifestyle change. Due to lack of a balanced diet, it is affecting people of any age with vitamin deficiency. They often accompany deficiencies in minerals (such as iron, zinc, and iodine). The population that is at most risk due to vitamin deficiencies are youngsters and pregnant women. The most typical vitamin deficits which occurs are B12, Iron, Zinc, Calcium, Magnesium, B1, B2, B3, B6, B7, and B9. As a result of advancements in artificial intelligence, machine learning, different ways are being developed in the medical profession and healthcare industry to treat various health issues. One effective method of supervised machine learning is the Support Vector Machine. regression and classification applications. The main principle behind the goal of SVM is to identify the ideal hyperplane for effectively dividing input data into distinct classes. For each class, the location of this hyperplane optimizes the margin, the distance between the hyperplane, and the closest data points. The data points nearest to the hyperplane, or support vectors, are critical in determining this decision boundary. Thanks to a method called the kernel trick, SVM is adaptable and able to handle both linear and non-linear connections between features. The collected datasets, comprising blood reports and symptoms related to deficiencies, are utilized to train SVM model. By learning from these datasets, SVM algorithm establishes an optimal hyperplane to effectively separate instances of deficiencies from non-deficiencies. The model is enhanced through the incorporation of information from blood reports and symptoms, facilitating accurate predictions. Integrated into a user-friendly chatbot interface, SVM model enables individuals to perform self-assessment by inputting their symptoms and relevant medical data.

Signs and symptoms of Vitamin B12 and Vitamin D deficiency zyla

Vitamin B12	Vitamin D
Feeling fatigued and lazy	Severe Asthma in children
Feeling sleepy most of the point	Cardiovascular disease
Low stamina	Cognitive impairment
Pale skin, ringing in the ear	Bone pain
Lack of appetite	Unexplained fatigue
Celiac disease, bacterial growth or parasite	Muscle weakness
Tingling sensation or numbness	Soft bones that may result in deformities
Immune system disorders	High blood pressure
Shortness of breath	Diabetes or cancer

Fig 1: Signs and Symptoms of Vitamin B12 and D deficiency

II. LITERATURE SURVEY

This survey paper includes review of the literature described by various authors. The following are the research questions addressed in this phase of the study: How does the existing vitamin deficiency detection mechanism emphasize over accuracy of correct detection?, What are the drawbacks of the existing researches carried out over the vitamin deficiency in human being?, How machine learning techniques can be used to detect vitamin deficiency?.

One of the related work “Efficient Prediction of Vitamin B Deficiencies via Machine Learning Using Routine Blood Test Results in Patients With Intense Psychiatric Episode” looks into vitamin B insufficiency in people undergoing severe mental episodes. Among 497 individuals at risk of damage, 22.5%, 16.1%, and 14.5% had vitamin B1, B12, and folate (B9) deficits, respectively. The study employs machine-learning models (such as k-nearest neighbors, SVM, and random forest) to accurately forecast deficits based on routine blood tests and patient data. The models, notably the random forest, showed strong generalization, offering promising areas beneath the operational characteristic curves of the receiver. Notably, there may be links between certain vitamin deficits and alkaline phosphatase (ALP) and thyroidstimulating hormone (TSH). According to the findings, machine learning can assist speed up risk classification and decision-making. Vitamin replacement treatment is used in mental patients who are vitamin deficient. More research is required to assess external generalizability and analyze the consequences for patient care and cost-effectiveness.

Another related research work “Machine Learning Approach of Detection of Vitamin D level: a comparative study”. The research involved 481 participants from the Internal Medicine Department at NEU Hospital. Four supervised ML models—Ordinal Logistic Regression (OLR), Elastic-net Ordinal Regression (ENOR), Support Vector Machine(SVM), and Random Forest(RF)—were compared in terms of their classification performance. The analysis considered sensitivity to metabolic syndrome (MtS) positive status, hyper-parameter tuning, sensitivity to training data size, and overall classification performance. Results indicated that SVM (RBF) performance was negatively affected by multicollinearity, while RF demonstrated robustness, especially in varying training data sizes. RF and ENOR outperformed other models in smaller training samples, showcasing resilience to multicollinearity. Comparative analysis favored the RF classifier, revealing superior accuracy (0.94), specificity (0.96), sensitivity or recall (0.94), precision (0.95), F1-score (0.95), and Cohen’s kappa (0.90).In conclusion, RF exhibited superior performance compared to SVM (RBF), ENOR, and OLR. These have implications for the development of an intelligent vitamin D detection system, leveraging routine clinical, biochemical tests, and lifestyle characteristics. This technique promises to simplify the determination of vitamin D levels, reducing cost and time in routine healthcare practices.

III. VITAMIN DEFICIENCY ANALYSIS

Lack of nutrition due to an imbalanced diet can manifest in various symptoms, reflecting the body's response to potential vitamin and mineral deficiencies. Recognizing these symptoms is vital for maintaining a balanced diet and addressing nutritional gaps. Specific symptoms arise based on body's interaction with essential nutrients. General manifestations include brittle nails, mouth ulcers or cracks at the corners of the mouth, poor vision, white growths on the eyes, redness of eyes, and a smooth tongue.

A yellow colour of nails may indicate a deficiency of fat-soluble vitamin, B, while mouth ulcers can suggest deficiencies in vitamin B1, B2, and B6. Scaly lips and cracks in the corners of the lips may signal deficiencies in vitamin B1, B2, B3, and iron. A smooth tongue texture and red colour indicate potential deficiencies in vitamin B6, B12, and iron. Redness in the eyes may point to deficiencies in vitamin A, B, B2, and B6.

Excessive secretion or dehydration can cause angular inflammation, such as cracks in the corners of the mouth, which is linked to insufficient intake of iron and B vitamins, notably B complex. Moon blindness, reducing the ability to see in low light or darkness, can result from a lack of fat-soluble vitamin. Tiny bumps on the tongue, appearing smooth and shiny, may be due to deficiencies in vitamin B12 and other nutrients, leading to soreness in the tongue.

Symptoms are not the only indicators used in this study; diagnosis is also accomplished by blood tests. Vitamin B12 deficiency is recognized if the blood level is less than or equal to 197-771 (ECLIA), and vitamin D deficiency is identified if the serum level is less than or equal to 20. The symptoms and their corresponding vitamin deficiency for the body organs such as Eyes, nails, tongue and lips is provided in Table 1

Body organs	symptoms	Vitamin Deficiency
Eyes	Redness	A, B, B2, B6
Lips	Cracked	B1, B2, B3, B6
	Cracks in corner	B1, B2, B3, Iron
	Shiny Red	B2, B3
Mouth	Mouth Ulcer	B1, B2, B6
Nails	Brittle, cracked, and dry	A, C, B7, B9, B12
	Spoon shaped	C, B7, B9
	Vertical ridges	Magnesium, B7, B9, Iron
	White spots	B7, B9, Zinc, Calcium
	Yellow color	C
Tongue	Red color	B12, Iron
	Smooth Texture	B6, B12, Iron
	White Patches	B2, B3, B12

Table 1. Symptoms of lips, tongue, nails and eyes and their corresponding vitamin deficiency

IV. CONCLUSIONS

It's evident that the approaches and concepts discussed above has a great potential for identifying vitamin B12 and D deficiencies in human bodies. By boosting the efficacy of medical science, the chosen programming approach has the obligation and potential to concentrate on the criteria. Every variable and piece of data in the research is supported by various credible pieces of evidence and reasoned assertions from various websites. Using appropriate AI, it may be concluded that the study can be utilized in the near future to reduce vitamin deficiencies in patients.

V. REFERENCES

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