

# A STUDY ON HEALTHY DIET FOR HYPOTHYROID DISEASE USING FUZZY LOGIC ALGORITHM

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## ABSTRACT:

In this era, unbalanced diet and lack of nutrition creates many diseases for human. Because of the poor eating habits like unhealthy food, fast-food and preservative food items people are suffering from a lot of diseases. One of the most common diseases caused by improper diet is thyroid. Thyroid was classified into hypothyroid and hyperthyroid. Among these, hypothyroid patients are more and women are suffering mostly by hypothyroid disease. The main objective of this research work is to analyze the healthy diet system for hypothyroid disease patients. In this study, healthy diet system for hypothyroid disease is analyzed using fuzzy logic algorithm by using QtFuzzylite tool. The input parameters are hypothyroid test, healthy and unhealthy nutrition for hypothyroid diet. The output parameters are health to classify the given data was poor, normal or good by the linguistic terms of fuzzy logic algorithm.

**Keywords:** Data mining, Fuzzy Logic Algorithm, Healthy nutrition diet, Hypothyroid.

## I INTRODUCTION

Thyroid is a gland that acts as the boss of our metabolism placed on the throat and known as Master gland. Although it weighs 20 grams and is about 3-4 inches long in a butterfly shape. Thyroid function refers to the gland itself seated in neck that supplies in the body with iodine and necessary hormones like TSH made in the pituitary gland. Thyroid is classified into hypothyroid and hyperthyroid. For this research work we have taken the healthy diet analysis for hypothyroid patients. Hypothyroidism is also called as underactive thyroid disease, is a common disorder with hypothyroidism. The gland which secretes less amount of thyroid hormone is called the hypothyroid and it is a common endocrine disorder. It can cause many health disorders. Hormones released by the gland travel through the bloodstream and affect nearly every part of the body from heart, brain, muscles and skin.

Healthy diet is right quantities of food from all different food groups which can promote good health. There are five main food groups of whole

grains, fruit and vegetables, protein, dairy, fat and sugar. The proportion has to be decided based on the calorie level requirement. Always choose the food with high nutrient density like fresh fruits, vegetables, whole grains and beans. Minimum 8 to 10 glasses of water for women and 15 glasses of water for men. Hence to analyze the healthy diet for hypothyroid disease fuzzy logic algorithm is used here to classify the health is poor, normal or good.

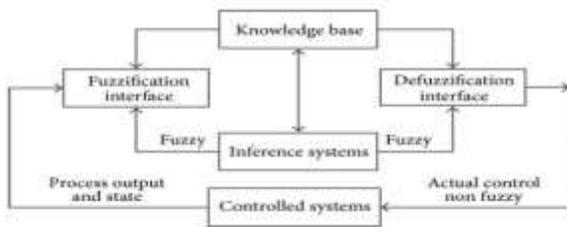
### A. Data Mining

Data mining is the process of searching large stores of data to discover patterns and trends that go beyond simple analysis. Mathematical algorithms are used in data mining for segmenting the data and evaluate the probability. In this research work classification is applied. To analyze the healthy diet for hypothyroid using fuzzy logic algorithm and it classifies the given output health is poor, normal or good based on the input variable. This data mining process is done by the fuzzy logic algorithm using QtFuzzylite tool. This is the work to analyze the diet taken by the hypothyroid disease patients and to classify their health is poor, normal or good.

Hence this process is done by the rules created according to the input and output variable. The rules are created using fuzzy logic algorithm.

## B. Fuzzy Logic Algorithm

Fuzzy logic is technology which works like human being feelings. It is flexible machine learning technique. Fuzzy logic was invented by Prof. Dr. Lotfi A. Zadeh, at the University of California, Berkeley during the year 1965. The linguistic variables are used, these degree may be managed by specific functions. Fuzzy logic is a flexible machine learning technique. Generally, a logic may have two values and it represents two solutions. But fuzzy logic is a multivalued logic and allows intermediate values to be defined. Fuzzy logic provides an inference mechanisms which can be interpret and execute the commands. Fuzzy logic is easy to understand and imprecise the data. It says the human thought. Fuzzy logic is the matter of degree of membership, any logical system can be fuzzified. It converts the crisp values(like boolean logic) into linguistic values. The linguistic values are the degree of membership function. It calculates the input membership values, the original value is converted into the membership values.



**Figure: 2. Structure of fuzzy logic system**

Fuzzy logic allows intermediate values, specifying the data from the raw data. Fuzzy logic results defined as partially truth, where the truth value may range between fully true and fully false. The truth values may be the real number between the 0 and 1. The advantage of the fuzzy logic is its ability to deal with vague systems. It leads to faster and simpler program development of system controllers.

## C. Problem Definitions

This study analyzed data of hypothyroidism patients healthy diet to classify the amount of nutrition taken by the patients is poor, normal or good. People are

affected by many diseases because of poor diet and lack of nutrient. To analyze this problem and to suggest healthy diet system this research work has done. In existing system general diet has been analyzed and recommended for the people by web data mining. In the proposed system the healthy diet is analyzed for hypothyroid disease and it classifies the patient health is poor, normal or good using fuzzy logic algorithm rules in the QtFuzzylite tool. The data collected from the UCI dataset repository of hypothyroid dataset

## D. Objective of the study

- To analyze the healthy nutrition diet for hypothyroid disease patients.
- To apply fuzzy logic to classify the data.
- To study QtFuzzylite tool

## II LITERATURE REVIEW

Shilpa Dharkar and Anand Rajavat proposed a recommendation system to study healthy diet using web data mining. In this they found that medical study has revealed that people set a bigger possibility of countering free radicals and warding of illness by consumption of healthy foods and by increasing their resistant system. Due to the poor eating habits people suffer from many diseases. In the current scenario fast food become important food in daily routine because it is effortlessly available but taking fast food in routine may cause for diseases like heart attack and diabetics. In terms of accuracy and time performance, recommendation system used two decision tree learning algorithm ID3 and C4.5 and apply it on healthy diet application.

B.M.Gayathri and C.P. Sumathi proposed their research work “Mamdani Fuzzy Inference System for Breast Cancer Risk Detection, found that diagnosing various diseases in medical field is very difficult even for medical expert. It discovers knowledge from the database. Fuzzy logic is one of the classifier in data mining. It is applied in many fields such as control theory, Artificial Intelligence(AI) and also in the field of medicine. It focuses on detecting the risk of breast cancer by using fuzzy logic. The aim of the study was to detect the breast cancer by reducing the variables,

so that it reduces the time taken for diagnosing the disease. The features were extracted by using one of the feature selection method called Linear Discriminant Analysis (LDA) and training is done by using one of the fuzzy inference method called mamdamani fuzzy inference model. The results were evaluated by using the above model. It gave the result of 93%.

E.Sivasankar and R.S. Rajesh proposed their research work in “Knowledge Discovery in Medical Datasets Using a Fuzzy Logic Rule Based Classifier. The study revealed that in the healthcare sector quality demands are rising for designing expert systems for medical diagnosis. At the same time growing capture of biological, clinical, administrative data and integration of distributed and heterogeneous databases create a complete new base for medical quality and cost management.

Nidhi Bhatla and Kiran Jyoti has proposed their research work in “A Novel Approach for Heart Disease Diagnosis using Data Mining and Fuzzy Logic”(2012), they found that, cardiovascular disease is a term used to describe a variety of heart diseases, illnesses and events that impact the heart and circulatory system. A clinical uses several sources of data and to test to make a diagnostic impression but it is not necessary that all the test are useful for the diagnosis of heart disease. The objective of the work is to reduce the number of attributes in the heart disease diagnosis that will automatically and then it reduce the number of tests which are required to be taken by a patient. It also aims at increasing the efficiency. The observations which is said that the decision tree and Naive Bayes using fuzzy logic has used over other datamining techniques.

V.Krishnaiah and G. Narasimha, N. Subash Chandra proposed a research work in Heart Disease Prediction System using Data Mining Techniques and Intelligent Fuzzy Approach. In this work, the healthcare trade usually clinical diagnosis ended typically by doctor’s knowledge and practice. Computer Aided Decision Support System plays a major task in medial field. Data mining provides the methodology and technology to alter these mounds of data into useful information for decision making.

Data mining tools says the tradequestions that normally in use much time literally to decide. In this paper can study number of papers related to this papers in which many algorithms of data mining used for the prediction of heart disease. As of the study observed that Fuzzy Intelligent techniques increase the accuracy of the heart disease prediction system.

Kantesh Kumar Oad and Xu DeZhi done his research work in “A Fuzzy Rule Based Approach to Predict Risk Level of Heart Disease”(2014), according to WHO, the people are suffering more from the heart disease and facing many difficulties in day to day life. To reduce risk, improved knowledge based expert systems played an important role and has contribution towards the development of the healthcare systems for cardiovascular disease. To make use of benefits of knowledge based system, it is necessary for health organization and users, must need to know the fuzzy rulebased expert system’s integrity, efficiency and deployments, which are the open challenges of current fuzzy logic based medical systems. In this proposed systems, designed a fuzzy rule based expert system and also by data mining technique we have reduced the total number of attributes. Our system mainly focuses on cardiovascular disease diagnosis and the dataset taken from UCI. The performance of the system matched with neural network and J48 decision tree algorithm.

Ashish Kumar Sen and Shamsheer Bahadur Patel , D. P. Shukla found the research in “A Data Mining Technique for Prediction of Coronary Heart Disease using Neuro-Fuzzy Integrated Approach Two Level” (2013), the cardiovascular disease remains the biggest cause of deaths worldwide and the heart disease prediction at the early stage is importance. This unused data can be converted into useful data. For this purpose we can use different data mining techniques. In this paper, it has defined a two layered approach for identifying the disease possibility. The critical factors that are mandatory for occurrence of coronary heart disease are taken at first level and the rest one are taken at second level. This two level approach increase the performance of the work as it helps in predicting disease chances accurately. The heart disease dataset is taken from UCI machine learning repository to train the neural

network and then fuzzy rules are applied to predict the chances of coronary heart disease as low, medium or critical.

### III METHODOLOGY

In this study we analyzed the healthy diet for hypothyroid disease using fuzzy logic algorithm in the QtFuzzylite tool. The dataset is taken from the UCI dataset repository of hypothyroid dataset and the amount of nutritional facts are taken from the website National Health Organization. The preprocessing technique is done by selecting the variables which is essential for the analysis of the healthy diet for hypothyroid disease and to classify their health.

Data preprocessing is the process of converting raw data to an understandable format. The raw data is nothing but the inconsistent data with the missing values. Before starting the implementation work the data must be cleaned, or else inconsistent or wrong results may get. The variables which are collected is reduced by the preprocessing and selected only the variables which is necessary to analyze the hypothyroidism patients healthy diet for classifying the diet is poor or normal or good. From the datasets of hypothyroid T3 (Triiodothyroxine), T4 (thyroxine), TSH (thyroid stimulating hormone) are selected and nutritional sources are taken from the website National Health Organization for the process of classifying the hypothyroid patients healthy diet is poor or normal or good.

To design the fuzzy logic system the correct input variable and the output variable is to be find out. Here to analysis healthy diet for hypothyroid disease and to classify the health, there are 8 input variables and 1 output variables are selected.

The input variables are used in this research work are cholesterol, T3 (triiodothyronine), T4 (thyroxine), TSH (thyroid stimulating hormone), iodine, selenium, gluten and cruciferous. Each and every input has their own linguistic terms according to their values. Here the input variables for T3 and T4 the linguistic terms are low and normal. The linguistic terms for remaining input variables for cholesterol, TSH, iodine, selenium, gluten and cruciferous are low and high. The output variable

which used here is health. It is to classify the given input is poor, normal or good.

**Fuzzify:** This system is designed by the fuzzy control language. The fuzzify process is done by the cholesterol, t3, t4, TSH, iodine, selenium, gluten and cruciferous with their linguistic terms low, normal and high.

**Defuzzify:** For the process of defuzzify is the health done by the centroid method, lock is range and the accumulation is maximum. Linguistic terms of the health is poor, normal and good.

### E. Steps for the process of analyzing the healthy diet for hypothyroid using fuzzy logic algorithm in QtFuzzylite tool

**Rule - 1** By double clicking the QtFuzzylite tool, it opens the new window. There are three columns are input variable, output variable and rules box.

**Rule - 2** Add the input variables in the input section by clicking the “+” symbol it opens the new box as add variable in that add the name of the input variable. And set the minimum and maximum values of the input variable.

**Rule - 3** Then add the linguistic terms of the input variable by clicking the “+” symbol next to the terms in add variable box. It opens a new box as add term. Add the linguistic terms and the values.

**Rule - 4** To add the remaining input variables follow the step2 and step3 to add the variables and their linguistic terms.

**Rule - 5** To add the output variable health the same step2 and step3 process is followed and in the edit output variable set the default as –infinite, lock as range, defuzzifier as centroid and the accumulation as maximum.

**Rule - 6** Click create the combination of rules for the rule creation then click the process rules to edit the good rules in the rules viewer box. The 12 rules are created in the rules box.

**Rule - 7** Click the process of control engine to set the values for the input to get the output values.

**Rule - 8** Set the input values for each input variable hence it gives the output values if the input

values are satisfied by the rules created in the rule box.

**Rule - 9** : The rules are highlighted in green color based on the strength of the rules satisfied by the given input variables.

## F. Fuzzy logic Rules to classify the health of the hypothyroid disease

The main part of the fuzzy logic is creating the rule base. The results are derived according to the rules set in the rules box. There are 12 rules created in the rule box. They are,

**Rule - 1** : If cholesterol is high and t3 is low and t4 is low and TSH is high and iodine is low and selenium is low and gluten is low and cruciferous is low then health is poor.

**Rule - 2** : If cholesterol is low and t3 is normal and t4 is normal and TSH is high and iodine is high and selenium is low and gluten is low and cruciferous is low then health is normal.

**Rule - 3** : If cholesterol is high and t3 is normal and t4 is low and TSH is high and iodine is high and selenium is high and gluten is low and cruciferous is low then health is good.

**Rule - 4** : If cholesterol is low and t3 is low and t4 is low and TSH is high and iodine is high and selenium is high and gluten is high and cruciferous is high then health is poor.

**Rule - 5** : If cholesterol is high and t3 is normal and t4 is normal and TSH is high and iodine is high and selenium is low and gluten is low and cruciferous is low then health is normal.

**Rule - 6** : If cholesterol is low and t3 is normal and t4 is normal and TSH is high and iodine is high and selenium is high and gluten is low and cruciferous is low then health is good.

**Rule - 7** : If cholesterol is high and t3 is low and t4 is low and TSH is high and iodine is high and selenium is low and gluten is high and cruciferous is low then health is poor.

**Rule - 8** : If cholesterol is low and t3 is normal and t4 is low and TSH is high and iodine is low and selenium is high and gluten is low and cruciferous is low then health is normal.

**Rule - 9** : If cholesterol is high and t3 is low and t4 is low and TSH is high and iodine is high and selenium is high and gluten is low and cruciferous is low then health is good.

**Rule - 10** : If cholesterol is low and t3 is normal and t4 is low and TSH is high and iodine is high and selenium is high and gluten is high and cruciferous is low then health is poor.

**Rule - 11** : If cholesterol is high and t3 is low and t4 is low and TSH is high and iodine is high and selenium is high and gluten is low and cruciferous is high then health is normal.

**Rule - 12** : If cholesterol is low and t3 is normal and t4 is low and TSH is high and iodine is high and selenium is high and gluten is low and cruciferous is low then health is good.

## IV RESULT

In this study we analyzed healthy diet hypothyroid disease using fuzzy logic algorithm. The attributes for hypothyroid are selected by the data preprocessing they are T3(triiodothyroxine), T4(thyroxine), TSH(thyroid stimulating hormone). Then the attributes for hypothyroid diet is iodine, selenium, gluten and cruciferous. If the given input data satisfies the rules then the output health is classified as poor, normal or good.

**Table 1. Output values and strength of rules**

RULE NUMBER	OUTPUT VALUES	STRENGTH OF RULE
1	1.350	0.752
2	2.366	0.649
3	3.386	0.502
4	1.388	0.502
5	2.358	0.712
6	3.387	0.498
7	1.414	0.373
8	2.418	0.365
9	3.411	0.373
10	1.385	0.520
11	2.372	0.613

## V CONCLUSION

This study shows that the people are suffering from hypothyroidism disease due to unhealthy foods, lack of nutrients and we analyzed the healthy nutrient diet for hypothyroidism disease patients by classifying the output health is poor, normal or good on the basis of the amount of nutrient taken. Hence it finds out the better analysis of healthy nutrient diet system for hypothyroidism disease

patients. Fuzzy logic algorithm were used in this research work. Number of attributes are collected from hypothyroidism disease patient datasets and from that selected attributes are taken according to doctor's knowledge. Fuzzy algorithm is implemented in QtFuzzylite tool. Fuzzy algorithm classified the selected attribute of nutrient poor, normal or good.

### RECOMMENDATIONS OF THE STUDY

- Follow healthy nutrient diet.
- Avoid poor diet.
- Avoid high level of emotional stress.
- Do exercise.
- Do yoga.
- Good rest and sleep.
- Drink minimum 8 to 15 glasses of clean water.
- Intake high fiber foods.
- Taking proper medications at starting stage.

### FUTURE WORK

In future this methodology can be implemented in any other healthcare and medical field. In future researchers can implement with some other diseases to analyze and also to recommend the healthy nutrition diet for those diseases. And can also analyze the healthy diet system for this disease with some other data mining algorithms with more attributes to get accurate outputs.

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