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A Comparative Analysis of Food Habit and Nutrition on Food in Bangladesh using Machine Learning

Md. Tofael Ahmed
Department of CSE
Daffodil International University
Dhaka, Bangladesh
tofael15-10782@diu.edu.bd

Md. Kamruzzaman
Department of CSE
Daffodil International University
Dhaka, Bangladesh
kamruzzaman15-11113@diu.edu.bd

Jannatul Ferdaous
Department of CSE
Daffodil International University
Dhaka, Bangladesh
jannatul15-11171@diu.edu.bd

Mst. Eshita Khatun
Department of CSE
Daffodil International University
Dhaka, Bangladesh
eshita.cse@diu.edu.bd

Abstract— Day by day, humans change their way of life. Eating habits are one of them. This research mainly focuses on the eating food habits and nutritional status of the people in Bangladesh. For a healthy and beautiful nation, food habits must be appropriate. Just as good eating habits keep our body healthy and energetic, bad eating habits make us sick. For this research, A data set is gathered on eating habits to find and learn about the food tastes of the people. Collected 1200 statistics from human's everyday meals habits. Split the data into breakfast, lunch, snack, street food, dinner, and sweets. This research target is to provide the best knowledge about nutrition on food habits because it is quite difficult to develop a country without a healthy nation. This research is divided into two steps. (i) finding food habits (ii) synthesizing information and finding nutrition. An annotated reference list is included for ease is finding another helpful guideline. For this research, seven different types of machine learning algorithms such as Decision Tree, KNN ADA boosting classifier, Logistic Regression, Bagging Classifier, Gaussian Naive Bayes, Extra Trees Classifier have been applied.

Keywords—Food habit, Nutritional status, Eating Quality, Nutrition knowledge, Dietary intake, Food pattern.

I. INTRODUCTION

Food is one of the five basic needs of the people of Bangladesh. And human habits are formed to meet basic needs. This research illustrates about the eating habits of the people and consuming food nutritional status. Food is essential to survive. And there is no end to the variety in human food. According to the geographical location of the earth, there are several varieties of the human diet chart. Most people eat three times in a day. In between also like to take light snacks in the afternoon or evening time. Mostly Bangladeshi people satisfied with pulses and rice, but in another country, peoples are satisfied with the food of each nation. Similarly, Bangladesh also has many variations of food in the different regions. For example, people all over the country are crazy about rice, but some people get satisfaction when they get Biryani. Commonly

Bangladeshi people enjoy homemade food. Also, enjoy street foods and foreign foods in the restaurant in urban areas.

Bangladesh is rich in green crops, rivers, canals and the sea are full of sea fish. So, the food production rate is very high. At different times, various cultures peoples live together in a country on a large scale. As a result, food diversity and food habits are changing continuously. The use of spoons instead of hands is on the rise and even, in cooking there is diversity. One thing that exists in the midst of all this is human eating habits at the bend of the road, various restaurants have sprung up in line with the times. There is a list of different types of food in the leaf menu. However, most of the time people are extremely prone to food on the side of the road. So, this research aim is to discuss the eating habits and food qualities of Bangladesh. Nutrition effects on physical and mental health. A healthy diet can lead to positive change any individuals.

This paper aim to present a comparative analysis of food habit and consuming nutritional state and identifying the accuracy rate from various machine learning algorithm aspects. The following paper is stated as follows. In section II, a literature review on food habit and food nutrition on different aspects are presented. In section III, the research methodology is discussed. Results and discussion are elaborated in section IV. Finally, conclusion is illustrated in section V.

II. LITERATURE REVIEW

At present, the researchers are showing their great effort in the area of food nutrition. In this section is presenting some of the researchers work that must enlighten our study.

A descriptive cross-sectional study has done among 144 children and they found that in rural areas, parameter Weight-for-Height (WHZ) projected that 1.39% of children were severely malnourished, 1.39% moderately

malnourished, 22.23% mildly malnourished and had no serious overweight, but in urban areas, 25%, 2.78%, and 1.38% mild, moderate and severe overweight respectively. For Weight-for-Age (WAZ), the results further stated that 38.8% children mildly underweight, 25% moderately underweight in rural areas and found the opposite result for urban area [1]. Another research has done with 80 street children with 90% boy and 10% gamines and the results shows that the underweight ratio 65%. About 77.5% of underweight children eat three meals a day and 22.5% of children eat only twice a day. Most of the children in the study, 85% developed the habit of washing their hands before eating. About 61.3% of them had been suffering from different diseases for the last 3 months before starting the study [2].

In this study, an attempt was made to evaluate the effect of diet on the condition of female regulation. The results of the study indicate that respondents' quality of life was largely perceived by their food intake. The ethnographic data of the respondents shows that the average height of the respondents was 159.20 semantic deviation 11.47. Respondents averaged 66.93 kg with a standard deviation of 9.2. Among respondents, 6% were obese, 12% were upward, 65% were general and 17% had low BMI (Body Mass Index) expression [3]. Cross sectional study has done among 394 students in Bangladesh. Among them, 26.67% gained weight as they were not engaged any physical works [4]. A study has been done among respondents aged 17 to 26 years. The British respondents were 19 years. Among them, 21.5% take over half breakfast and lunch 70.1% and 81.3% respectively. The majority 56.9% eat fruit one to two times, 50.5% eat fast food once a week and 51.4% drink 2 liters of water again. 33.8% eat vegetables once or twice [5]. In the month of Ramadan 2018, 78% of pregnant Muslim women were practicing daily fasting. More than 80% of community women believe they should Pregnancy is fast and more than 50% expect positive health effects on mother and unborn child. And increased consumption of pulses, dairy foods, fruits, and large fish. Dietary diversity has increased, albeit slightly the day of not fasting in Ramadan. Both fasting and non-fasting in Ramadan seem to improve the food quality of Muslim women in the rural population of Bangladesh. These research results explained the scenario of Ramadan during pregnancy. And contributes to a better understanding of the consequences of later life and thus the impact of maternal nutrition on the development of healthy children [6].

Aziz.et.al. showed that, the technology of data mining in a dataset for a ranking of three diets on the respondents has also advantages and limitations such as large amount of manipulation before analysis replications with the same results from the analysis result and also find the quality of documenting the results. CRISP-DM (Cross-Industry Standard Process for Data Mining) has been used in this report to get the result of data analysis. The process of CRISPDM is data understanding, data preparation,

modeling, evaluation and deployment. They used dataset collected from 78 respondents on different data mining algorithms also visualized the results through various clustering and simulations in a heatmap matrix for better algorithm evaluation and data set understanding [7]. The patient diet recommendation system recommends appropriate and diverse foods for 4,444 patients by individually tracking the overall health status of 4,444 patients. The Dietary Recommendation System (DRS) is carefully used to provide diets that can be used as dietary supplements for patients and suggestions for foods that meet health requirements, tastes and dietary preferences. Opportunities for the development of DRS to automatically suggest diets for different patients with the consideration of different types of disease, health status, age and gender. Including cliques in the DRS along with the deep learning model improves the accuracy and validity of the deep learning method [8].

This research looks at aimed to decide the health, dietary expertise and the nutritional conduct of college students in China. As a result, this research recorded the distribution of BMI amongst Chinese college students and determined a low occurrence of weight problems, a locating this is regular with a look at of Japanese women college students (BMI \geq 25 obese changed 4.6% BMI>30 of weight problems changed into 0%). In the United States, 35% of the university college students are suggested to be obese or obese (BMI \geq 25) According to the WHO definition of weight problems, BMI>30 is the cut-off point. The definition is primarily based totally on studies of Caucasian populations. Asian populations are suggested to have a better frame fat (%) at a decrease BMI as compared to Caucasians [9].

The purpose of this study was to identify factors that promote healthy lifestyle behavior in US college students. Opinions and recommendations for effective and coordinated intervention programs or environmental changes that support a healthy diet were presented using an ecological framework that combines psychological, social, and environmental strategies. This study emphasizes the importance of consulting college students in developing a healthy campus-wide dietary intervention for a dietary service or program [10].

III. RESEARCH METHODOLOGY

In this research, used 80% training data and 20% test data from our collected 1200 dataset. There are 828 male and female 372. In the dataset, collecting age 15-25 around 828 data, 25-40 around 277 data, and 40+ around 118 data. This research employed seven machine learning algorithms such as Decision Tree, KNN, ADA Boosting Classifier, Logistic Regression, Bagging Classifier, Gaussian Naive Bayes, and Extra Trees Classifier. The working process has been illustrated, in Fig. 1.

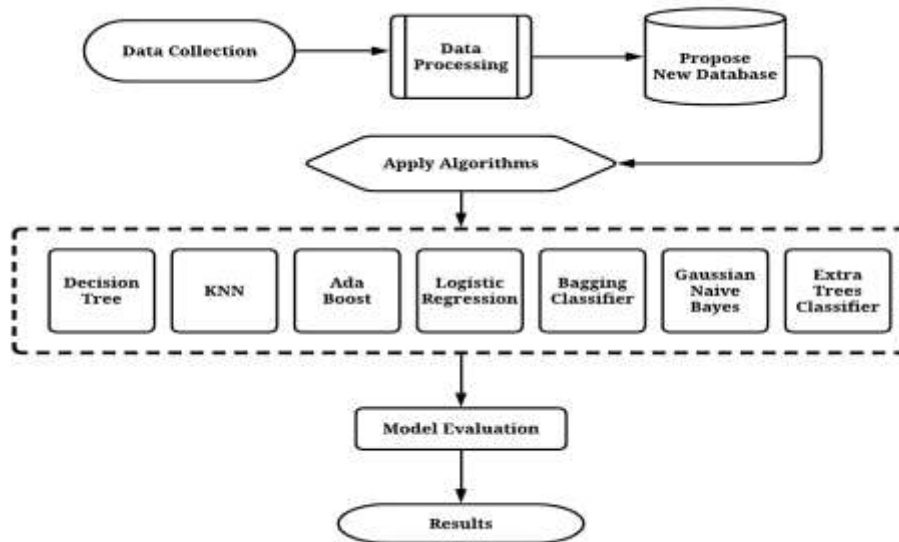


Figure 1: Steps of Research Methodology

First, find data collection, prepare the new database, then preprocess the dataset. Propose the new datasets, then applying seven types of algorithms in new databases which are shown in figure 1. After using algorithms process the new database and evaluate the datasets and after all this research making decisions, all several sections Breakfast, Lunch, Dinner, Street Food, and Dessert using machine learning algorithms by calculating accuracy. This research applied seven various types of machine learning algorithms.

Decision Tree: A decision tree is a tree model. Use partitioning rules to distribute features to smaller partitions with similar response values. Use divide-and-conquer method Create a tree diagram. Decision trees require very little preprocessing. Categorical features can be easily managed without any pre-processing [11].

K-Nearest neighbors (K-NN): K-NN is a straightforward directed AI calculation. Arrangement and relapse issues can be addressed with the K-NN calculation. K-NN calculation remembers the preparation perception for grouping the concealed test information. K-NN calculation gets comparative things that exist in a nearby area.[12]

ADA Boost Classifier: Yoav Freund and Robert Shapir propose an ADA boost or adaptive boost in 1996. Create a

classifier as a combination of several classifiers with poor performance. Set the weights of the classifier and train the data at each iteration [11].

Logistic Regression: Logistic Regression used logistic functions, which are called sigmoid functions. A sigmoidal curve takes the actual value and places it in the range 0 to 1 [12].

Bagging Classifier: A classifier is an ensemble meta-estimator approach that selects a default classifier for each random subset of the original dataset and then combines the individual predictions to form the final prediction [12].

Gaussian Naïve Bayes: Naïve Bayes is one of the most established AI calculations. This calculation depends on Bayes hypothesis and essential measurements. Likelihood classes and conditionals is utilized in one sided model. Extend the properties utilizing Gaussian appropriation [11].

Extra Trees Classifier: Extra trees classifier is an ensemble studying approach that mixes the effects of a couple of décor-associated selection timber accrued as a “forest” to output a type result [12].

Table I: ACCURACY OF VARIOUS ALGORITHMS

	Decision Tree %	KNN %	Ada Boost %	Logistic Regression %	Bagging Classifier %	Gaussian NB %	Extra Trees %
Breakfast	97.50	97.50	67.92	69.60	97.5	65.83	97.5
Lunch	84.2	87.92	67.92	66.25	83.75	57.67	84.17
Dinner	88.75	83.75	52.5	63.75	87.92	57.10	88.75
Snack	77.92	65.42	68.75	17.25	73.33	71.25	72.92
Street Food	93.33	84.58	63.75	61.25	93.33	57.50	9.33
Dessert	85.42	84.58	68.33	64.58	82.30	70.33	85.42

IV. RESULTS AND DISCUSSIONS

Food nutrition is essential for human body. If the nutritional status is low, human body will feel dull and exhausted [13].

In Bangladesh, everyone takes breakfast, lunch, snacks, dinner at regular basis eating time. For a healthy nation, people need a healthy food habit. Nowadays people face various kinds of diseases from bad food habits like diabetes, high blood pressure, heart diseases etc. For that, everyone should knowledge about the nutrition of food. Which food needs most which not at time. Everyone also needs to maintain body mass index (BMI). Every person is expressed as a form of weight in kilograms (kg) divided by height in meters squared (m²). It is possible to categorize the degree of obesity using the internationally recognized areas, starting with low weight (BMI<18.5), normal weight (BMI = 18.5 - 24.9), pre obesity (BMI = 25.0 - 29.9) and obesity (BMI 30.0) In addition, obesity was divided into three classes: class I (BMI = 30.0 - 34.9), class II (BMI = 35.0 - 39.9) and class III (BMI above 40) [14]. A nutritious diet is necessary for living a healthy life. Malnutrition is one of the reasons behind various types of non-communicable diseases. Dietary pattern has changed due to increased manufacturing of processed foods, swift urbanization as well as changing lifestyle. People are consuming foods likely heavy in energy, fats, sugars, and salt/sodium on the other hand many individuals aren't eating enough fruits, vegetables, and other dietary fiber like whole grains [15].

Breakfast: Breakfast is one of the most important meals of the day. It absorbs nutrition from the body early. Everyone should have breakfast from 7-9 am And Calories shouldn't exist. 300 to 400 calories for breakfast. By using algorithms, find out the results about breakfast as given below. People give Five stars on: green tea:417, boil egg:391, fruit:386, tea:366, bread;356, vegetable :357, rice:222, paratha :213, pulses:219, coffee:210, jelly:163. Breakfast food calories data show in table II.

This research shows that people choose green tea best in the morning. 100gm green tea there are no fat and carbohydrates, only minerals and protein. Green tea increases metabolism in the human body to keep good BMI rate. Most people 2nd choice is Boil Egg. A Boiled egg gives 78 calories. Minerals, protein, fat 5.3 and carbohydrate 0.6. People should know that boil egg is good for our bodies. So, this one is also good for our body. 3rd choice is fruit, fat 0.2 carbohydrates 14, calories 52. bread and vegetables are in 5th position. In Vegetables calories 65. Fat. 0.1, carbohydrate 13. To have a healthy lifestyle everyone needs to be concerned about daily food habits. For breakfast, everyone has to take green tea, fruits, egg, Bread, and vegetables. In Morning, if people drink chia seeds or lemon with warm water on an empty stomach it's so helpful for human body. And human should keep our food calories in the 300-400 range. Need to make sure that people get enough calories in the morning. And also concern about healthy food [16].

Table II: BREAKFAST ITEM FOOD CALORIES DATA

ID	Name	Weight	Calories	Protein	Fat	Carbohydrates
1	Paratha	100gm	336	6.4	13	45
2	Fry Eggs	100gm	90	6.3	6.8	0.4
3	Boil Egg	100gm	78	6.3	5.3	0.6
4	Coffee with sugar	1 cup	65	2.3	1.2	11
5	Bread, Jelly	100gm	131	2.6	01	28
6	Bread	1 slice	67	2.2	0.8	12
7	Pulses	100gm	116	09	0.4	20
8	Rice	100gm	130	2.7	0.3	28
9	Fruit Apple	100gm	52	0.3	0.2	14
10	Vegetables	100gm	65	2.9	0.1	13
11	Coffee	1 Cup	02	0.3	0.1	00
12	Tea	100gm	02	00	00	0.5
13	Green Tea	100gm	02	0.5	00	00

Lunch: Lunch is an essential meal of the day. It remains the body and brain working with full energy. According to the specialist, lunch provides nourishment to the body and brain, reduces stress, offers a break from the activities of the day and gives energy for the rest of the afternoon. From dataset, collected information about lunch where get people's needs. Standardized plates when looking at the ideal lunch. Celery should have 500 to 700 calories at a

time for lunch. There is no particular food that is "ideal" in and of itself. What people should eat for lunch should be balanced with what they should have for breakfast and what they are likely to have for dinner, and don't forget about snacks in between. And today needs to be reconciled with yesterday and tomorrow in terms of what people ate or will eat.

After analyzing the lunch dataset, findings show that: 1st position chicken -503, 2nd Beef -494, 3rd Rice -487, 4th Veg-426, 5th Pulse -398, 6th Fish -343. So, see that people are most interested in chicken. Given a calorie measurement chart in table III. Most people like chicken, beef more than vegetables and fish. But for an ideal lunch vegetable and fish are better for health. In Bangladesh, people always prefer rice for lunch. Since people have to calculate calorie intake for lunch, if a human eats 100 grams of rice, it has 130 calories and carbohydrates 28.

So, when humans eat rice, if humans eat vegetable curry it's best for our body. Body gets vitamins, calcium, and iron from different types of vegetables. Other hand, 100gm fish have 146 calories, carbohydrates 1, and protein 17. People can eat fish along with vegetables as an ideal lunch. In the dataset also add pulses. Then people can eat beef, Biryani for some days in a month and chicken for every week per day. But people need to make eating habits with vegetables and fish, pulses. People also avoid soybean oil as much.

Table III: LUNCH ITEM FOOD CALORIES DATA

ID	Name	Weight	Calories	Fat	Carbohydrates	Protein
1	Rice	100gm	130	0.3 g	28 g	2.7 g
2	Biryani	100gm	142	4.6 g	15 g	9.6 g
3	Fish Curry	100gm	128	2.7 g	0 g	26g
4	Chicken	100gm	220	13 g	0.1 g	24 g
5	Beef Curry	100gm	250	15 g	0g	26g
6	Pulses	100gm	116	0.4 g	20 g	9 g
7	Vegetable	100gm	65	0.1 g	13 g	2.9 g

Dinner: In Bangladesh, people eat dinner at the end of the meal. The ideal time to have dinner is before 7 pm and intake 500 to 700 calories. From the collected data, it shows that chicken, fish, beef, vegetables are the first choice for dinner. Pulses are in the second position. Bread in 3rd position and rice is in 4th position. Find that people like bread more than rice for dinner. So, this is a good sign for a healthy habit. But they like chicken, beef, fish, and

vegetables in the same position. For dinner, vegetables and fish are the ideal food for dinner. People should avoid beef at dinner. Human can take chicken at dinner, but only one piece. To intake any food for our body, first, everyone has to measure the percentage of the calories. In table IV, food nutrition chart is given where people can easily find out the measurement of nutrition on food. People mustn't eat more than 700 calories.

Table IV: DINNER ITEM FOOD CALORIES DATA

ID	Name	Weight	Calories	Fat	Carbohydrates	Protein
1	Rice	100gm	130	0.3 g	28 g	2.7 g
2	Bread	100gm	266	3.3 g	49 g	8.9 g
3	Fish Curry	100gm	128	2.7 g	0 g	26g
4	Chicken	100gm	220	13 g	0.1 g	24 g
5	Beef Curry	100gm	250	15 g	0g	26g
6	Pulses	100gm	116	0.4 g	20 g	9 g
7	Vegetable	100gm	65	0.1 g	13 g	2.9 g

Street Food: Four out of five students skip breakfast due to a variety of reasons. Students often opt for fast food after finishing classes, such as from varsity canteens or other street food outlets [17]. Nowadays, more than 2.5bn people eat street food per day from around the whole world [18]. In the urban area, street food has become integral part of the food culture. It also plays a vital role due to appease the appetite of the many people in Bangladesh. Nevertheless, experts and food lovers are concerned about is the daily intake of harmful street-vended food [19]. Most Bangladeshi people love to eat street food. According to physicians, street foods which are being produced in an unhygienic state, may raise the risk of typhoid, hepatitis A and E, and other waterborne

diseases like cholera and diarrhea. After gathering statistics on street food, it has become a prominent part of eating habits in recent years in Bangladesh. Analysis shows that a variety of street foods exist in Bangladesh. In the future, the dataset will be larger for research. From the dataset, people vote, grill-nan (350), chola (334), jhal muri (320), chanachur (317), singara (302), velour (293), fukha (268). Though the street food is not good for health, it becomes part of Bangladeshi people daily food habits.

Snacks: Snacks are regularly much more minor than everyday food and are typically served besides main meals. Snacks are available in many forms, including packaged processed ingredients and homemade. A snack

is just a kind of food. It can't be called a meal or a necessary food. People often eat it while watching TVs or other relaxing things, or maybe they feel hungry. Many kids love it, and it may cause unhealthy issues. On the other hand, if people control its use, it will be good for the body [20].

For research, collected only two items for snacks: dessert items and street food because most people take their snacks as dessert items and street food.

1. Fried burnt food
2. Tea and coffee.

From the dataset,

Yes 696

No 504

This research finds that, 51.1% people are interested in taking snacks regularly and 48.9% of people are not interested in taking snacks regularly.

Dessert: Dessert is a kind of candy meal. It is a kind of meal that is had after lunch or supper, and in a few instances after a short chew. It is typically a candy meal, just like frozen yogurt, treats, and cakes. In certain nations, cheeses, for example, herbal products are crammed in as dessert. In addition to the 3 meals, people devour dessert objects like avenue meals. In Bangladesh unique varieties of the glad occasion, people cherished delivering dessert/candy objects. Though people cherished eating cakes, people bought to restrict the consumption of dessert objects via means of energy measurements. Limiting consume of free sugars to less than 10% of total energy intake (2, 7) is part of a healthy diet. For additional health benefits, a further reduction to less than 5% of total energy intake is suggested [21].

V. CONCLUSION

Human Health is a major concern to develop a nation. In this paper, analyze the eating habits and nutritional status of the people of Bangladesh. This research suggests optimizing nutrition on people's daily meals by using machine learning algorithms. And discuss what kind of food people eat when and at what time and at what stage with the information about nutrition. This research based on a variety of foods that people consume, from heavy meals to light street food. In this study, all kinds of results have been discussed in detail in different ways and at different stages. The analysis results of the study have been published through various lists of foods and algorithms accuracy. This research dataset is currently working on 1200 data and through this data people can find out about the habit of food, the number of nutrients in the food, which food, how many calories and which food will affect our body. In the future, datasets will add more food in our form and work in different areas and countries. In the future, this research will work on a huge number of datasets and through this data, people will be able to know about the quality of food, food habit of different countries and areas and the number of nutrients in the food, the number of calories in the food, and the effect of any food on our body. Also, work on more algorithms and more visualization also. It will help our

nation to have a healthy life. In future, a nutritional model by using machine learning algorithms may be suggested. For this research dataset will collect as much data as possible.

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