

Chapter 3

3 Analysis and Design of the Nutrition-Based Recommendation System (NBRS) Model

3.1 Introduction

The development of the Nutrition-Based Recommendation System (NBRS) requires a systematic approach to both the analysis and design stages. This chapter focuses on breaking down these processes to ensure the system provides effective, personalized dietary recommendations. The NBRS model aims to assess user health and nutritional needs while aligning them with food preferences and restrictions.

The analysis phase involves identifying key requirements such as user health data, dietary goals, and constraints. This ensures that the system can gather and interpret information correctly to recommend balanced meal plans. We also review current recommendation systems and the gaps that NBRS aims to address, such as providing more accurate nutrient-based advice.

The design phase transforms these requirements into a structured solution. This includes creating system architectures, defining algorithms for nutrient calculations, and establishing interfaces for user interaction. The NBRS model is designed to be flexible and user-friendly, utilizing data-driven techniques to offer precise recommendations based on user input.

This chapter lays the foundation for understanding how the NBRS model can support healthier eating habits and provide a personalized nutrition experience.

3.2 Study of Cardiac Patients

The study of cardiac patients is essential for developing a Nutrition-Based Recommendation System (NBRS) for individuals with heart problems in the Gujarat region. This research gathers detailed information about the dietary habits, preferences, and nutritional needs of cardiac patients to create personalized dietary recommendations that can help manage and improve their heart health. The primary objectives include understanding dietary habits and preferences, identifying specific nutritional needs, collecting data on commonly consumed foods, and analyzing the nutritional content of these foods.

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To achieve these objectives, the study utilized both primary and secondary data collection methods. Primary data collection involved surveys and questionnaires designed to gather information directly from cardiac patients. These tools collected data on the types of foods patients commonly eat, their preferences, and their ratings of various foods. Patients were asked to rate more than 90 different food items on a rating from 1 to 10 based on their personal preferences. This data provided valuable insights into the foods that cardiac patients genuinely like and prefer.

In addition to primary data, secondary data collection was conducted to gather existing information on Gujarati food and fruit items. This included nutritional values and calorie specifications for various foods. The researcher carefully chose foods that are highly recommended for individuals with heart conditions, organizing them into 15 different categories, such as meals, fruits, vegetables, and traditional Gujarati foods like roti, bhakhri, thepla, dal, and rice. For fruits, options included apples, mangoes, and more. This organized dataset helped manage and analyze the various food options beneficial for cardiac patients.

The study also considered the seasonal availability of specific foods or fruits to ensure that recommendations align with what is fresh and accessible during different times of the year. This approach allowed for personalized dietary guidance that considers both nutritional needs and seasonal factors.

The comprehensive analysis of the data involved calculating daily calorie requirements for men and women based on their Basal Metabolic Rate (BMR) and considering user preferences for different types of food. This dual approach ensured that the recommendations addressed both the nutritional needs of individuals and their personal tastes and preferences. By understanding the dietary habits and preferences of cardiac patients, this research aimed to develop a robust and personalized NBRSS that can significantly contribute to the heart health of individuals in the Gujarat region.

3.3 Food Dataset for Cardiac Patients

Developing a comprehensive food dataset for cardiac patients is crucial for providing accurate and personalized dietary recommendations. This dataset includes detailed information on various foods that are commonly consumed in the Gujarat region, focusing on their nutritional values, caloric content, and suitability for individuals with heart conditions. The dataset is divided into two main categories: Gujarati food and fruits, each carefully

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curated to ensure that the foods included are heart-healthy and beneficial for managing cardiovascular health. Gujarati cuisine is known for its rich variety of flavors and dishes, many of which can be adapted to meet the nutritional needs of cardiac patients. The food dataset includes traditional Gujarati foods such as roti, bhakhri, thepla, dal, and rice. Each item is analyzed for its content of essential nutrients like fat, fiber, carbohydrates, and protein, along with its caloric value. For example, thepla, a type of flatbread made from whole wheat flour and fenugreek leaves, is included due to its high fiber content and beneficial nutrients. Similarly, dal (lentil soup) is highlighted for its protein content and low fat, making it a suitable option for heart patients. By categorizing these foods and detailing their nutritional profiles, the dataset helps in creating balanced meal plans that align with the dietary restrictions and health goals of cardiac patients.

Fruits are an essential part of a heart-healthy diet, providing vital vitamins, minerals, and antioxidants that support cardiovascular health. The dataset includes a variety of fruits that are both popular and nutritionally beneficial for cardiac patients. Fruits such as apples, which are rich in fiber and vitamin C, and mangoes, known for their antioxidant properties and high vitamin A content, are included in the dataset. Each fruit is evaluated not only for its nutritional benefits but also for its caloric content and seasonal availability. This ensures that recommendations can be tailored to include fresh, locally available fruits that patients are likely to enjoy and benefit from. By incorporating a wide range of fruits into the dataset, the NBRS can offer diverse and appealing options to help cardiac patients maintain a healthy and enjoyable diet.

By compiling this detailed and structured food dataset, the researcher ensures that the nutritional recommendations provided by the NBRS are both scientifically sound and culturally appropriate. This comprehensive approach helps to ensure that the dietary guidance is practical, sustainable, and effective in promoting heart health among the target population. By focusing on both Gujarati foods and fruits, the dataset respects local eating habits and preferences, making it easier for patients to follow the recommended diet. This dual focus on nutrition and cultural relevance is key to the success of dietary interventions for cardiac patients in the Gujarat region. Overall, the creation of this food dataset represents a significant step forward in providing personalized nutritional advice for cardiac patients. It bridges the gap between medical dietary requirements and everyday eating habits, ensuring that patients receive guidance that is not only beneficial to their health but also enjoyable and easy to follow. This

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careful curation and analysis of local foods will help patients make informed dietary choices that support their heart health and improve their overall well-being.

3.3.1 Gujarati Food

To develop a comprehensive and detailed dataset for cardiac patients, the researcher has categorized over 90 Gujarati food products into 14 different tables. Each table is organized to provide nutritional values that are essential for managing cardiovascular health. Here is the detailed breakdown in table format followed by a descriptive explanation:

Sr. No.	Product Table Name
1	Nutritive Value for (Main Meal)
2	Nutritive Value for (Snack)
3	Nutritive Value for (Main Meal) Dal & Subji (Counted the Nutritive value for 1 Bowl)
4	Nutritive Value for (Snacks)
5	Nutritive Value for (Leafy Vegetables) (1 Small Bowl)
6	Nutritive Value for (Other Vegetables) (1 Small Bowl)
7	Nutritive Value for (Sambhara) (2 Tablespoon)
8	Nutritive Value for (Milk Product) (1 Small Bowl)
9	Nutritive Value for (Cereal + Pulse Product) (1 Small Bowl)
10	Nutritive Value for (Cereal + Vegetable Product) (1 Small Bowl)
11	Nutritive Value for (Pulse + Vegetable Product) (1 Small Bowl)
12	Nutritive Value for (Cereal + Pulse + Vegetable Products) (1 Small Bowl)
13	Nutritive Value for (Milk + Pulse Product) (1 Small Bowl)
14	Nutritive Value for (Oil Seeds Product) (1 Small Piece)

Table 1 Nutritive Gujarati Foods Category

Descriptive Explanation

To ensure the nutritional recommendations are accurate and beneficial for cardiac patients, the researcher developed a comprehensive dataset categorized into 14 distinct tables. Each table focuses on specific types of food products commonly consumed in Gujarat, providing detailed nutritional values essential for managing cardiovascular health.

The first category, "Nutritive Value for (Main Meal)," includes traditional Gujarati main meal items like roti, bhakhri, and thepla. These foods are analyzed for their macronutrient content, including fats, proteins, carbohydrates, and fibers, as well as their caloric content.

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Understanding the nutritional makeup of these staples helps in formulating balanced meal plans for cardiac patients.

In the "Nutritive Value for (Snack)" table, popular Gujarati snacks are listed, with a detailed analysis of their nutritional content. Items such as sev and khakhra are included, ensuring that even the snacks recommended for cardiac patients contribute positively to their overall dietary requirements. This table helps in identifying healthier snack options that align with heart health guidelines.

The "Nutritive Value for (Main Meal) Dal & Subji (Counted the Nutritive value for 1 Bowl)" table focuses on traditional Gujarati dishes like dal and subji. These are common components of a typical Gujarati meal and are evaluated for their nutritional values per one bowl servings. This table provides essential insights into the protein, fiber, carbohydrate, and calorie content of these dishes, making it easier to recommend heart-healthy meal options.

For leafy and other vegetables, the researcher created separate tables: "Nutritive Value for (Leafy Vegetables) (1 Small Bowl)" and "Nutritive Value for (Other Vegetables) (1 Small Bowl)." These tables list common vegetables, detailing their nutritional values per small bowl servings. Including such vegetables in the diet is crucial for providing essential vitamins, minerals, and fibers, all of which are beneficial for heart health.

The "Nutritive Value for (Sambhara) (2 Tablespoon)" table includes Gujarati salads, analyzed for their nutritional values per two tablespoons servings. These salads are often made with raw or lightly cooked vegetables and are rich in vitamins and minerals, contributing positively to a heart-healthy diet.

Dairy products are covered in the "Nutritive Value for (Milk Product) (1 Small Bowl)" table, listing items such as curd and paneer. These are analyzed for their protein, calcium, fats, and caloric content, ensuring that the dairy recommendations provide adequate nutrition without compromising heart health.

Additionally, combinations of cereals, pulses, and vegetables are documented in several tables, such as "Nutritive Value for (Cereal + Pulse Product) (1 Small Bowl)," "Nutritive Value for (Cereal + Vegetable Product) (1 Small Bowl)," and "Nutritive Value for (Pulse + Vegetable Product) (1 Small Bowl)." These tables help in recommending balanced dishes that provide a mix of essential nutrients beneficial for cardiac patients.

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To ensure a variety of healthy food options, the researcher also includes tables for more complex combinations like "Nutritive Value for (Cereal + Pulse + Vegetable Products) (1 Small Bowl)" and "Nutritive Value for (Milk + Pulse Product) (1 Small Bowl)." These tables document the nutritional values of dishes combining multiple food groups, providing a holistic view of their dietary benefits.

Oil seeds and fruits are also important for heart health. The "Nutritive Value for (Oil Seeds Product) (1 Small Piece)" table includes items like sesame and flax seeds, known for their healthy fats and fiber content.

By organizing the food products into these 14 tables, the researcher ensures a detailed and structured approach to understanding the nutritional values of Gujarati foods. This comprehensive dataset forms the foundation of the Nutrition-Based Recommendation System (NBRS), allowing for personalized dietary recommendations tailored to the specific needs of cardiac patients. This structured methodology not only helps in managing cardiovascular health but also aligns with the cultural and dietary preferences of individuals in the Gujarat region.

3.3.2 Fruits

To complement the comprehensive dataset for cardiac patients, the researcher also developed a detailed dataset for fruits. This dataset is crucial for providing accurate and personalized dietary recommendations, focusing on the nutritional values, caloric content, and suitability of various fruits for individuals with heart conditions. The table format below outlines the fruit category followed by a descriptive explanation.

Sr. No.	Product Table Name
1	Nutritive Value for (Raw Fruits) (1 Medium Size)

Table 2 Nutritive Fruits Category

Descriptive Explanation

To ensure the dietary recommendations are both nutritious and heart-friendly, the researcher created a detailed dataset for fruits commonly consumed in the Gujarat region. This dataset is organized under the table "Nutritive Value for (Raw Fruits) (1 Medium Size)," providing a thorough analysis of each fruit's nutritional values per medium-sized serving. This approach ensures that the recommendations are specific and relevant to the dietary habits and preferences of cardiac patients.

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The dataset includes a variety of fruits such as apples, mangoes, bananas, and more, each evaluated for their macronutrient content, including fats, proteins, carbohydrates, and fibers, as well as their caloric content. Fruits are a vital component of a heart-healthy diet, providing essential vitamins, minerals, and antioxidants that help in managing cardiovascular health. By documenting the nutritional values of these fruits, the researcher aims to guide cardiac patients in making informed choices that support their heart health.

Apples, for example, are included in the dataset due to their high fiber content and low calorie count, making them an excellent choice for heart health. The nutritional analysis details the amount of dietary fiber, vitamins, and minerals in a medium-sized apple, emphasizing its benefits in reducing cholesterol levels and improving heart function.

Mangoes, another popular fruit in Gujarat, are analyzed for their rich content of vitamins A and C, dietary fiber, and antioxidants. The dataset provides a comprehensive breakdown of the nutritional values, helping cardiac patients understand how mangoes can be incorporated into their diet without compromising their health.

Bananas are also included in the dataset, known for their high potassium content, which is beneficial for maintaining healthy blood pressure levels. The nutritional analysis of a medium-sized banana highlights its role in providing essential nutrients while being easy to digest, making it a suitable option for cardiac patients.

In addition to these common fruits, the dataset includes a variety of other fruits like oranges, papayas, and pomegranates. Each fruit is meticulously evaluated to ensure that the recommendations cover a broad spectrum of nutrients necessary for heart health. Oranges, for example, are rich in vitamin C and fiber, while papayas provide a good source of antioxidants and vitamins. Pomegranates are noted for their polyphenol content, which has been linked to improved heart health.

By organizing the fruits into this detailed table, the researcher ensures that the dietary recommendations are based on a robust understanding of the nutritional benefits of each fruit. This structured approach allows for personalized dietary guidance tailored to the specific needs of cardiac patients, considering both their nutritional requirements and cultural preferences.

This comprehensive dataset on fruits forms a crucial part of the Nutrition-Based Recommendation System (NBRS), which aims to provide heart-healthy dietary

recommendations. By focusing on the nutritional values of fruits, the researcher ensures that the recommendations are not only beneficial for managing cardiovascular health but also culturally relevant and easily accessible to individuals in the Gujarat region. This meticulous methodology supports the goal of promoting better dietary habits among cardiac patients, ultimately contributing to improved heart health and overall well-being.

3.4 Nutrition-Based Study

The relationship between diet and cardiac health is well-established, making it crucial to understand the nutritional composition of traditional foods, particularly in regions where these foods form a central part of daily life. This study focuses on the nutritive values of various Gujarati foods to develop effective dietary recommendations that can benefit cardiac patients. The primary aim is to identify dietary patterns within Gujarati cuisine that can support cardiovascular health and manage common risk factors associated with heart disease.

In conclusion, the nutritional analysis of traditional Gujarati foods provides a foundation for developing personalised dietary recommendation for cardiac patients. Emphasizing high-fiber foods, lean proteins, and healthy fats while minimizing high-calorie snacks and simple carbohydrates can significantly improve heart health. Continuous research and monitoring of dietary habits are essential for refining these recommendations and ensuring their effectiveness in promoting cardiovascular health.

The nutritional values of the various Gujarati foods studied are detailed in the following 14 tables. These tables encompass a wide range of traditional dishes and ingredients, highlighting their protein, carbohydrate, fat, fiber, and calorie contents. The tables include main meals such as plain steamed rice, roti, bhakhri, and paratha, snacks like khakhra and pudla, and dals and subjis like red gram dal and green gram subji. Leafy vegetables such as fenugreek leaves and radish leaves, as well as other vegetables like brinjal and cauliflower, are also analyzed. Additionally, the nutritional content of sambharas (salads), milk products, cereal and pulse products like khichdi and dhokla, and oil seed products such as groundnut chikki, are provided. Each table presents specific nutritional data that is critical for developing dietary recommendations, particularly for cardiac patients, ensuring a balanced intake of essential nutrients.

3.4.1 Nutrition-Based Study for Gujarati Food & Fruits

The state of Gujarat in India is known for its rich and diverse culinary heritage. Gujarati cuisine is characterized by its vibrant flavors, extensive use of spices, and a balance between different food groups. For a comprehensive understanding of the dietary habits and nutritional intake of the population, especially cardiac patients, it is essential to analyze the nutritional values of traditional Gujarati foods and fruits. This study aims to provide detailed insights into the nutritional content of these foods, utilizing standard equations to convert macronutrient content into caloric values.

Nutritional Equations

To determine the caloric values of different macronutrients in food items, the following equations are employed:

Fat: 1 gram of fat equals 9 calories.

Carbohydrate: 1 gram of carbohydrate equals 4 calories.

Protein: 1 gram of protein equals 4 calories.

Fiber: 1 gram of fiber equals 2 calories.

These equations are universally recognized and provide a reliable method to calculate the total caloric content of food items based on their macronutrient composition. By applying these equations, we can derive the nutritional values for various Gujarati dishes and fruits.

Database for Gujarati Food & Fruit Items

In our nutrition-based study, an extensive database has been created, which includes a variety of traditional Gujarati food items and local fruits. This database is crucial for analyzing the dietary habits of the population and understanding the potential health impacts, especially for those with cardiac conditions.

For instance, consider the traditional dish "Undhiyu," a mixed vegetable dish that is a staple in Gujarati cuisine. By breaking down the ingredients and using the nutritional equations, we can calculate the following:

Fat: If the dish contains 10 grams of fat, it contributes 90 calories ($10 \times 9 = 90$ calories).

Carbohydrate: With 30 grams of carbohydrates, it adds 120 calories ($30 \times 4 = 120$ calories).

Protein: With 10 grams of protein, it contributes 40 calories ($10 \times 4 = 40$ calories).

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Fiber: With 5 grams of fiber, it adds 10 calories ($5 \times 2 = 10$ calories).

Total Calories: $90 + 120 + 40 + 10 = 260$ calories.

To calculate the total caloric content of a small bowl of Gujarati Dhokla based on the given macronutrient values, we will use the provided equations for each macronutrient:

Given values for Gujarati Dhokla (1 small bowl):

Protein: 2.5 grams

Carbohydrates: 5.7 grams

Fat: 2.5 grams

Fiber: 1.05 grams

Now, we calculate the calories from each macronutrient:

Calories from Fat:

Calories from Fat = $2.5 \text{ grams} \times 9 \text{ calories/gram} = 22.5 \text{ calories}$

$\text{Calories from Fat} = 2.5 \text{ grams} \times 9 \text{ calories/gram} = 22.5 \text{ calories}$

$\text{Calories from Fat} = 2.5 \text{ grams} \times 9 \text{ calories/gram} = 22.5 \text{ calories}$

Calories from Carbohydrates:

Calories from Carbohydrates = $5.7 \text{ grams} \times 4 \text{ calories/gram} = 22.8 \text{ calories}$

$\text{Calories from Carbohydrates} = 5.7 \text{ grams} \times 4 \text{ calories/gram} = 22.8 \text{ calories}$

$\text{Calories from Carbohydrates} = 5.7 \text{ grams} \times 4 \text{ calories/gram} = 22.8 \text{ calories}$

Calories from Protein:

Calories from Protein = $2.5 \text{ grams} \times 4 \text{ calories/gram} = 10 \text{ calories}$

$\text{Calories from Protein} = 2.5 \text{ grams} \times 4 \text{ calories/gram} = 10 \text{ calories}$

$\text{Calories from Protein} = 2.5 \text{ grams} \times 4 \text{ calories/gram} = 10 \text{ calories}$

Calories from Fiber:

Calories from Fiber = $1.05 \text{ grams} \times 2 \text{ calories/gram} = 2.1 \text{ calories}$

$\text{Calories from Fiber} = 1.05 \text{ grams} \times 2 \text{ calories/gram} = 2.1 \text{ calories}$

$\text{Calories from Fiber} = 1.05 \text{ grams} \times 2 \text{ calories/gram} = 2.1 \text{ calories}$

Finally, we sum the calories from all macronutrients to get the total caloric content:

Total Calories = $22.5 \text{ (Fat)} + 22.8 \text{ (Carbohydrates)} + 10 \text{ (Protein)} + 2.1 \text{ (Fiber)} = 57.4 \text{ calories}$

Therefore, a small bowl of Gujarati Dhokla contains approximately 57.4 calories.

To ensure the accuracy of our study, our database incorporates data from established nutritional sources, scientific literature, and government resources. Each entry includes detailed information on the macronutrient content and caloric values, calculated using the standard equations. This allows for a thorough analysis of the nutritional quality of Gujarati foods and fruits.

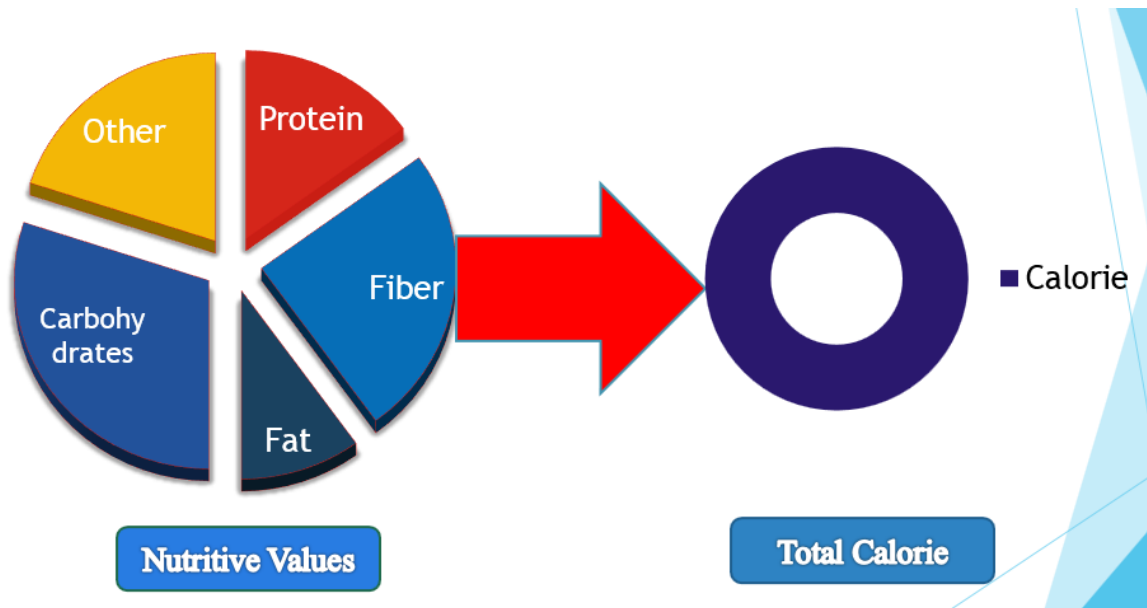


Figure 14 Nutrition-Based Calculation for Calorie

This comprehensive nutritional profiling is vital for understanding dietary patterns and making informed dietary recommendations, particularly for cardiac patients. By identifying nutrient-dense foods, we can support better health outcomes and promote healthier eating habits among the population.