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# Nutrition Expert System for Gestational Diabetes

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## Abstract

Nutrition includes the food intake and absorption, assimilation of the nutrients from food for proper growth of an individual. Gestational diabetes is a type of diabetes that is developed only in pregnant women. In this project, we take certain inputs (height, weight, age, blood sugar, etc.) from a pregnant woman and use them to recommend a dietary plan for her to nurture her health and of the newborn. The diet plan is a result of outputs from the rule sets corresponding to the inputs. A feedback mechanism is incorporated to understand her needs better and to determine how effective has been the recommended plan. The knowledge base updates itself based on the feedback received.

## 1 Introduction

Humans consume tons of sugar, fats, and processed foods every year. Not everything they consume is healthy. Having a proper meal plan is a necessity for pregnant women to avoid health related problems for herself and her child. A proper diet contains essential vitamins, minerals and other nutritive fibers. The diet should take into consideration the blood sugar levels and aim towards maintain it within a normal range.

An expert system is a computer program that provides expert advice as if a real person had been consulted where this advice can be decisions, recommendations or solutions <sup>[5]</sup>. The intention of this project is to help women with gestational diabetes have a balanced intake of the nutrition required by them. The rule base in our system is built around various attributes of the woman (age, height, weight, blood sugar level, etc.) and their relationships with each other. The project focuses on recommending an ideal meal plan.

Further, we take inputs from the user asking her for her blood sugar level after every meal. The next meal is prepared / modified as per the current blood sugar level. This part acts as the feedback mechanism. If a suggested meal leads to increase in the blood sugar level, we design the next with low carbohydrate content to stabilize it. These women are sensitive to carbohydrates in the morning so the breakfast usually has a low carbohydrate content which gradually increases as the day progresses.

## 1.2 Problem Statement

To develop an expert system that takes as input a pregnant woman's (with gestational diabetes) profile and suggests a diet plan to maintain her blood sugar level.

## 2 Preliminaries

### 2.1 Gestational Diabetes

Gestational Diabetes develops during usually during week 24 to week 28 in pregnant women and affects how the cells use glucose leading to high blood sugar levels. The blood sugar levels return to normal soon after delivery. But, if a woman is diagnosed with gestational diabetes she's at risk for type 2 diabetes. The prevalence of gestational diabetes is as high as 9.2%. Expectant women can treat gestational diabetes by maintaining a proper diet and exercising along with necessary medication.

### 2.2 Dietary requirements

Pregnant women are sensitive to carbohydrates in the morning. So, their breakfast needs to be low on carbohydrate content and it gradually increases as the day progresses. No meal has a 0% carbohydrate intake and every meal needs to be carbohydrate consistent. The day is divided into 6 meals spaced no more than two hours consisting of three normal meals and three snacks. The nutrients in a meal should comprise of 50% from carbohydrates, 25% to 30% from proteins and 20% to 25% from fats. Additionally, meals should have enough iron content. No meals should be skipped after taking an insulin shot.

These women are supposed to gain weight even if they are overweight before pregnancy. An overweight woman needs to gain at least 15lbs and the weight gain for normal women should be anything between 25lbs to 30lbs. A 15mins to 20mins walk is recommended as well for such women.

### 2.3 Blood Sugar levels

The target blood sugar levels for women with gestational diabetes are given in Table 1. These targets do not differ by weight, age, trimesters, etc. Anything below 80 is dangerous. If the blood sugar level drops below 80, an emergency snack is to be consumed with high fat content and should have at least 15 grams of carbohydrate.

Time of the Day	Targets
Before meals and when she wakes up	95 or lower
1 hour after eating	140 or lower
2 hours after eating	120 or lower

**Table 1. Target blood sugar levels**

## 2.4 Harris-Benedict Equation

The Harris-Benedict equation is a method used to estimate an individual's basal metabolic rate (BMR) and daily kilocalorie requirement. The estimated BMR value is multiplied by a factor corresponding to the individual's activity level. The resulting number is the recommended daily kilocalorie intake.

$$\text{BMR for women} = (10 * \text{weight in kg}) + (6.25 * \text{height in cm}) - (5 * \text{age in years}) - 161$$
$$\text{Daily kilocalorie requirement for gestational diabetic women} = \text{BMR} * 1.475$$

## 3 Approach

The System was designed and implemented in Prolog. To run it the user uses some prolog terminal and consults the Diabetes File. The predicate `go()` executes the program. From here the user can either enter a new profile or get a meal recommendation. They just enter the number of the command they want to use. Command 1 allows the user to enter a new profile, it will prompt for the needed information, enter it without any spaces and followed by a period. After creating a profile the user can use `go()` to open to prompt again and use command 2 to get a meal recommendation. Command 2 will ask for your name in your profile, give it and it will either ask you to make a profile or if you already have then it will ask you for which meal you would like to get a plan for (Currently only Breakfast and Snack have options but more foods can be easily added, this is just for the proof of concept). It will then output every possible meal from its list of appropriate foods match the user's nutritional needs. Command 3 exits to command prompt. Your profile is retained until you exit your Prolog shell.

## 4 Future Work

Being able to update accordingly for a failed meal recommendation proved to be complicated to balance correctly in our short POC, so we were not able to implement it currently. However, this can be done with more time and design. Also, more advanced options and a more user friendly interface are needed. The ability to save profiles across sessions as well. Obviously adding more food options as well as considering cooking methods would add a lot of functionality. Finally, optimization of meal building, one of the reasons there were so few food options is adding too many more caused the search time to blow up.

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