

NUTRIBASE - Data Base for Nutritional Evaluation and Dietetic Treatment in Populational Metabolic Diseases

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Abstract: The nutritional evaluation and diet prescription are laborious and require much time. They need calculations of basic nutritional indices, to precisely diagnose and finally to indicate the proper nutritional recommendations based on demographic, anthropometric, biochemical data and medical history of the patient. Our purpose was to create a new strategic approach to increase the rapid elaboration of nutritional evaluation, calculation of carbohydrate controlled diets and a software implementation. We named the outcome application Nutribase. The application could be used in clinical settings and/or nutritional research environments for calculating the composition of diet in diabetes and other metabolic disturbances, for helping dieticians and nutrition professionals as well as an educational instrument for patients and students. Nutribase (an Access based software) collects data on nutritional and biological parameters related to dietary assessment and treatment of the subjects with metabolic diseases but not only, calculates the body mass index, ideal body weight and metabolic requirements of patients, provides ready-made diet models and recommendations according to the calculated metabolic requirements, diagnosis, provides tables of composition of foods (calories, carbohydrates, proteins, lipids), allows an assessment of diet composition per meal, provides a flexible educational instrument for creating or adjusting a diet according to the patients' preferences, is very much time saving in clinical settings and it may be adapted for epidemiological nutritional studies.

Keywords: Nutrition; Databases; Metabolic disease; Access.

Introduction

Nutritional aspects in metabolic diseases

Metabolic diseases like diabetes, obesity, dyslipidemia or others, threaten today the entire world population mainly because they lead to a high cardiovascular risk or due to several complications (kidney, liver, nerve damage) thus increasing both morbidity and mortality.

Epidemiological data show that diabetes mellitus affects over 315 millions of people around the world, there are over 400.000 diabetic patients in Romania, almost one third of Europeans are obese while the proportion reaches 50% in the US, the: metabolic syndrome (a combination of obesity, dyslipidemia, hyperglycemia, hypertension) has an overall prevalence of 22% in US population, varying from 10 to 25% in different regions of Europe. The prevalence of these diseases is increasing all over the world and in Romania as well.

A healthy diet is a valuable and accessible non pharmacological instrument for both prevention and treatment of the metabolic diseases.

The role of the nutritionist is to “create” diets that are correct from the nutritional point of view but also palatable, diverse, flexible and individualised as the diagnoses on one hand and the skills of the health carer on the other hand, allow. Because metabolic diseases are chronic conditions and

dietary nutritional recommendations are the basis and sometimes the only treatment required to control the condition, the above mentioned conditions of a diet are crucial for maintaining the compliance of the patients.

Making up a quantitatively correct diet which is compulsory for example in intensified insulin treated diabetes mellitus (where after some training the patients themselves should be able to calculate and adapt the diet) requires calculations of the metabolic needs according to anthropometrical and biochemical parameters of the individual. For the formulas used, there are several options, according to different authors or nutritional schools.

The Nutribase Application

The purpose of the study is to create an instrument for nutritional doctors, an instrument they can use to increase the precision and rapidity of calculation and to divert the diets offer to the patients. We build a database on nutritional items that could be used in clinical settings and nutritional research environments for calculating the composition of diet mainly in diabetes, for helping dieticians and nutrition professionals with rapid calculation of carbohydrate controlled diets as well as for patients with diabetes, to learn and to improve their personal skills in constructing a balanced diet.

The database should be an accessible instrument for the nutritionist; it should offer flexibility in introducing new parameters and offer the possibility of further statistical analyses with professional programs like SPSS. The big amount of calculation in nutritional assessment is very much time consuming when using conventional methods and many times it is a big burden for the patient who has to follow the indications, especially in strictly controlled diets.

For the above reasons we decided that the relational database software Microsoft Access 2000, would give the best results when used by nutritionists for nutritional assessment and follow up of patients with metabolic diseases.

A thorough nutritional assessment performed according to the algorithm presented, the implementation of a new diet, the follow up of patients and their diets, may be very laborious and time consuming.

That is why an application containing the information on patients and the composition of foods at hand would increase the quality and efficiency of the consultation and would also be extremely useful for future population nutritional assessment research or studies.

Objectives

1. To collect data on nutritional and biological parameters related to dietary assessment and treatment of the patients with metabolic diseases;
2. To calculate the BMI (body mass index), IBW (ideal body weight) and metabolic requirements of patients;
3. To provide ready-made diet models and indications according to the calculated metabolic requirements, diagnosis;
4. To provide (at request) lists of composition of foods (calories, carbohydrates, proteins, lipids);
5. To provide an assessment of diet composition per meal.
6. To provide models of building a diet “on the spot” - according to the patients’ preferences.

Material and Method

Algorithm for nutritional evaluation and diet prescription

After establishing the metabolic diagnosis, the next step is to build a diet according to the general indications.

1. The first step to calculate the daily caloric intake is to appreciate the basal metabolic rate (BMR) using the equations below:

Table 1. Calculation of basic metabolic rate [1 - 3]

	18-30 years	31-60 years	>60 years
Males	$0.063 \cdot W(\text{kg}) + 2.9857$	$0.0484 \cdot W(\text{kg}) + 3.6534$	$0.0491 \cdot W(\text{kg}) + 2.4587$
Females	$0.0621 \cdot W(\text{kg}) + 2.0357$	$0.0342 \cdot W(\text{kg}) + 3.5377$	$0.0377 \cdot W(\text{kg}) + 2.7545$

The result must be multiplied by 240 to get it in kcal/day.

Corrections for daily activity multiply by:

- 1.3 for moderate activity;
- 1.5 for strenuous activity.

Correction for body weight is calculated through calculating the BMI (body mass index = $W(\text{kg})/H(\text{m}) \cdot H(\text{m})$) and the ideal body weight IBW:

Table 2. Calculation of ideal body weight [4, 5]

Males	$50 + 0.75 \cdot (H-150) + (\text{age}-20)/4$
Females	$[50 + 0.75 \cdot (H-150) + (\text{age}-20)/4] \cdot 0.90$

*H= height in cm

The energy requirements are estimated as follows [4-7]:

- BMI = 22-25 kg/m²
 - active person: 31-35 kcal/kg ideal body weight;
 - moderate activity: 26-31 kcal/kg ideal body weight;
 - sedentary: 22-26 kcal/kg ideal body weight;
- BMI >25 kg/m² less than 22 kcal/kg ideal body weight;
- BMI <22 kg/m² over 35 kcal/kg ideal body weight.

2. Once established the calorie requirements they must be converted into macronutrients requirements (i.e. carbohydrates, proteins and lipids) which in a balanced diet should have the following distribution [2, 4, 7 - 10]:

Carbohydrates (CH)	55%;
Proteins (P)	15%;
Lipids (L)	30%;

using the conversion rates:

1 gram carbohydrates	4.1 kcal;
1 gram proteins	4.1 kcal;
1 gram lipids	9.3 kcal.

3. The results of these calculations give the amounts of carbohydrates, lipids and proteins ideal for the daily intake of the patient. Further, this amount should be divided into three to five meals: three main meals and two intermediate (possibly optional), so that the carbohydrate intake is spread throughout the whole day, in a balanced manner, according to the needs.

4. These figures are still quite abstract and must be further converted into quantities of food that should be weighted by the patient until he/she becomes able to appreciate the carbohydrate composition of a certain amount of a given food or meal. Food composition tables are used for these conversions.

5. In the patients with diabetes virtually all type of foods could be permitted as long as the carbohydrate count per day and per meal is carefully followed (*no plus and no minus*, especially for people on insulin).

Practically it makes no sense (and it is harmful because of rapid growth of blood glucose) in eating 60 g of sugar - 100% carbohydrates) for a meal that should contain 60g of carbohydrates, or, equally nonsensical, to eat 1.5 kilos of tomatoes. Although the mathematical calculations are correct, the physiological absorption of the same nutrient - the carbohydrates, is different from different foods, it raises blood glucose very rapidly and harmfully in the case of sugar, which is highly concentrated in carbohydrates and too slowly in the case of tomatoes, which have a low concentration of carbohydrates.

Table 3. Sample of basic food composition table used for calculating the diet composition in diabetes [2, 7, 8]

Food 100 g/100 ml	calories	carbohydrates	proteins	lipids
Milk (skimmed)	50	4.9	3.5	1.9
Yoghurt (semi skimmed)	54	4.0	3.2	2.6
Cottage cheese	90	4.0	18.0	1.2
Beef meat	134	0.0	17.0	7.0
Pork meat (lean)	142	0.0	20.4	6.3
Potatoes (new)	80	17.4	0.2	1.7
Cucumbers	19	2.9	0.2	1.3
Mushrooms	35	2.3	5.0	0.5
Egg (medium* 60g, hen)	171	0.6	14.0	12.0
Apples	67	15.0	0.3	0.5
Banana	66	13.4	1.3	0.6
Cream (sour)	302	3.1	2.5	30
Sugar	410	100	0.0	0.0

6. The next step is to write down the menu consisting of foods that the patient intends/would like to eat at a particular meal (for example breakfast) and then to calculate from the table of food composition, the number of food items and quantities until the result is satisfactory: first from the nutritional point of view and second, palatable to the patient (very important in maintaining long term compliance and adherence of the patient to the diet).

7. Once the meals for the whole day are written down and calculated, further adjustments are usually needed to check that overall daily protein, lipid and caloric intake does not exceed the recommended intake calculated at step 2.

The application was made using Microsoft Access 2003 [11-16].

Results

The presented application is based on an algorithm propose for the nutritional clinicians. The application collects data set for a patient related data:

- Demographic and identification data: name, surname, file number, birth date, consultation date, sex, age;
- Anthropometric data: weight, height;
- Level of physical activity data necessary for the calculation of basic nutritional parameters as BMI and daily calorie intake;
- Other data required for metabolic diseases diagnosis, evaluation of treatment and follow-up:
 - o abdominal circumference, systolic and diastolic blood pressure;
 - o basic laboratory parameters (pre-breakfast and two hours post-breakfast glycemia, HbA1C, total cholesterol, HDL cholesterol, triglycerides, liver enzymes AST and ALT, creatinine, proteinemia and uric acid.

The application contains food composition related data:

- Composition of foods: name of the food, category (meats, vegetables, fruits, dairy, starch, fats, sweets, other) calories, carbohydrates, proteins, lipids per 100g or per 100ml in case of liquids;
- Quantity of a certain food(s) ingested or intended for a meal;
- Number of meals and macronutrient spread over one day.

In order to create tables which each addresses an item of the database we grouped the data set for the patient in one main table “Patient data” and related data in other “Computations”.

These data can be introduced in a form call “Patient data” and in related subforms “Computations”.

Figure 1. Form view of the Form “Patient Data” for the homonymous table

Figure 2. From view of the Form “Computations”

The “Daily necessary energy” button has attached an “on click” action that opens a subform corresponding to the “Date Patient Query” which displays the nutritional parameters, nutritional requirements and the quantitative composition of the calculated/ indicated diet.

Figure 3. Form view when the “Daily necessary energy” action button on the main form is pressed displaying the calculated nutritional parameters

Another table refers to the composition of foods: “Food composition table”. The entries of this table will represent the other set of data necessary for the calculation of the macronutrient and energy composition of the daily diet.

In order to the database to be fully functional, this table must have as many entries as possible, i.e. as many foods from which the nutritionist and the patient may choose.

The table “diet type” also needs to be pre-filled with data prior to patient data entries when running the application as it contains the types of diets (balanced low calorie, low cholesterol, low protein, in hyperuricemia, etc) in the “Diet type” field. Another field call “Calorie” was fill with the diets displayed in increments of 100 calories: from 800 kcal to 2000 kcal.

In the memo type field “Description”, another field from table “Diet type”, the entries consist of the ready made daily diet models for calorie calculated diets and indications for the other type of diets of qualitative restrictions.

“Diet” is the name of a table for retain in the database the menu chosen and/or recommended “on the spot” at one particular date. For aliments the menu chose in the table “Diet” we create table “Patient food” which contains for each aliment an article.

A second Form corresponds to the food composition dataset, in this form the foods and their quantities are introduced for further calculation of the calorie and macronutrient amount which may be displayed in the form of a report by pressing on the Preview button. This form allows changing quantities and types of food until the total amount of macronutrient per meal/per food is the recommended one and is also palatable to the patient.

When?	Food	Quantity
▶ Dimineata	iaurt integral	200
Dimineata	sunca presata	30
Dimineata	paine alba	70
Gustare ora 10	grepfruit	200
Pranz	carne de pui	150
Pranz	andive	150
Pranz	cartofi pireu cu margarina 5c	250
Pranz	pere	150

Figure 4. “Personalized diet calculations” Form displaying the making of “on the spot” diet menu

The “Diagnostic” table is another table with information related to the patient.

If the practitioner wants to print the list of aliments and their content for each patient and to view the total of quantity, glucoses, lipids and protein, he can view a query or print a report with this data.

As a result of discussion with the patient, nutritional clinicians prescribe a principal diet that the patient will follow. We created the report presented below to print the recommended diet for each patient.

Discussing the diet with the patient and adapting it to his/her personal preferences leads sometimes to foods that are avoided or others who are less usual generally but often used by the patient or to try new recipes. In this case it is very much at handy to provide a patient with a personalized list of food composition table which he/she can use at home. In view of this the Report “Food content table” may be printed and given to the patient.

Another kind of report, useful for the nutritionist, for epidemiological or diet treatment evaluation purposes concerns the entries of patients grouped by certain criteria and from different tables in the Report Wizard as it is for example the “Calorie calculations” or “Glycemic nutritional evaluations.”

Discussion

Further refining of the database and of the flexibility of the project may have the following directions:

1. Widening the choice of ready-made diets
 - for one week;
 - summer/winter;
2. Widening the choice of foods with data from other reliable nutritional sources from abroad as the choice of foods is increasing in diversity due to a great variety of cooking and ingredients coming from other countries
 - more food groups in the database;
 - more foods (even exotic ones);
3. Widening the nutrient calculations to subgroups;
4. Widening the database and extend calculations to minerals, fiber, vitamins, fatty acids.

Conclusions

The NutriBase database fulfils the aims for which it was intended.

It may be used to help nutrition professionals to make diets and nutritional recommendations in a fast and coordinated way.

It is an educational instrument for the patients and students, to teach them how to make a correct diet of their own.

This application requires assistance of a nutritionist for validation of the diet indications (for a correct diagnosis); it is not an expert system.

The database is a valuable instrument for further analyses in the frame of large nutritional studies.

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