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SPECIAL ARTICLE / *ARTIGO ESPECIAL*

Technology in Health: Brazilian version of the GloboDiet program for dietary intake assessment in epidemiological studies

Tecnologia em Saúde: versão brasileira do software GloboDiet para avaliação do consumo alimentar em estudos epidemiológicos

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ABSTRACT: The 24-hour recall (R24h) has been the method for dietary assessment in surveys. Technological advances have allowed the development of a program for the collection of R24h data. International Agency for Research on Cancer-World Health Organization (IARC-WHO) developed a standardized interview and computer-based 24-hour dietary recall program called GloboDiet, aimed at using it in research and nutrition surveillance. Brazil was included in a project for the global expansion of this methodology for developing and adapting a version for national use. The adaptation followed the procedures established by the IARC-WHO that considered the translation and adaptation of approximately 70 databases. For the development of the food list, national databases of food consumption from national surveys were consulted obtaining a final list of 2113 foods and recipes. GloboDiet program guides an interview in five steps: general information of the participant; quick list of foods and recipes; details of food / recipes and quantities consumed using mainly a picture book; control of the amount of food and nutrients; and information on dietary supplements. The Brazilian version of the GloboDiet program will provide a more accurate assessment of food intake based on a standardized method for nutrition surveillance and investigation of the relationship between diet and health outcomes, as well as comparisons of dietary intakes within and between countries.

Keywords: Food consumption. Program. Nutrition surveillance. Diet. Nutrition surveys.

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RESUMO: O Recordatório Alimentar de 24 horas (R24h) tem sido o método de escolha para a avaliação da dieta em inquéritos populacionais. Os avanços tecnológicos permitiram o desenvolvimento de *softwares* para a coleta de dados de R24h. A International Agency for Research on Cancer-World Health Organization (IARC-WHO) desenvolveu metodologia para avaliação do consumo alimentar de forma padronizada e personalizada, o GloboDiet, com o objetivo de utilizá-la em pesquisas e em estudos de vigilância alimentar e nutricional. O Brasil, inserido em um projeto para expansão global dessa metodologia, desenvolveu e adaptou uma versão para uso nacional. A adaptação considerou a tradução e adequação de aproximadamente 70 bases de dados. Para a elaboração da lista de alimentos, foram consultados bancos de dados nacionais de estudos de consumo alimentar, obtendo-se um rol de 2.113 alimentos e receitas. O *software* GloboDiet orienta uma entrevista que se desenvolve em cinco etapas: informações gerais do participante; lista rápida de alimentos e receitas; detalhamento dos alimentos/das receitas e das quantidades consumidas por meio, principalmente, do manual fotográfico; controle da quantidade de alimentos e nutrientes; e informações sobre o uso de suplementos dietéticos. A versão brasileira do *software* proporcionará uma avaliação mais acurada do consumo alimentar com base em uma metodologia padronizada para fins de vigilância alimentar e nutricional e de investigação da relação da dieta com desfechos em saúde, além de permitir a comparabilidade dos dados de consumo alimentar em estudos no âmbito nacional e internacional.

Palavras-chave: Consumo alimentar. *Software*. Vigilância nutricional. Dieta. Inquéritos nutricionais.

INTRODUCTION

Diet is one of the lifestyle-related aspects that plays a key role in overall health conditions, with relevant repercussions on overall health, yet it is one of the most difficult individual attributes to measure[1,2].

The methods for evaluating food consumption are mostly based on reports involving the description and quantification of food consumed. The 24-hour Food Recall (R24h) consists of describing and quantifying in an interview all foods and beverages consumed by the interviewee on the day before the interview[3]. More recently, R24h has been pointed out as the method of choice to be used to investigate the relationship between diet and health outcomes due to the level of detail that can be obtained with its application[4].

Before the widespread use of personal computers, information was collected on paper, but technological advances led to the development of software that automated and standardized the conduct of the interview for the application of R24h[5]. The first study in automating and standardizing individual food consumption data collection was conducted by the International Agency for Research on Cancer-World Health Organization (IARC-WHO), with the development of the EPIC-Soft program.

EPIC-Soft was created to ensure the standardized collection of the R24h in 24 centers from 10 European countries participating in the European Prospective Investigation into

Cancer and Nutrition (EPIC)[6,7] project, as well as conducting the R24h interview with a development approach aimed at minimizing collection errors and ensuring high standardization of method application[6].

On the basis of the successful European experience, the methods developed for EPIC-Soft have now been devised and subsequently applied in other world regions such as Asia, Africa and Latin America to enable global comparison of food consumption and offer a unique opportunity to relate research results and monitor activities in food and nutrition[8-10]. Since 2014, because of the expansion of EPIC-Soft to other regions, this project has become known as GloboDiet.

Brazil is currently one of the Latin American countries that are part of the global initiative aimed at adapting existing international methods of collecting dietary data on an individual basis using the GloboDiet program. Accordingly, the following are the steps of the program structure, procedures and experiences of Brazilian researchers in the translation and adaptation of methods for the development of the Brazilian version of GloboDiet, with the purpose of developing a tool to evaluate the food consumption, providing dietary monitoring in the country and investigating the relationship between diet and health outcomes.

DEVELOPMENT OF PROGRAM

The development included the translation and adaptation of approximately 70 databases between common and country-specific archives. Common files included those related to the general list of foods and recipes, the determination of the level of description, the types of quantification methods, the survey questions, the algorithms, and the content of the program screens. On the other hand, among the specific archives were those related to the list of foods and recipes with the inclusion of regional items, specificity of the level of description, methods of quantification (review of home measurements, addition of photographs and standard units), polling questions (addition of new questions), coefficients (addition/revision of cooking coefficients, edible part, density) and translation into the country's language of program screens[11].

We highlight the use of existing national study databases. Thus, food information, especially food consumed in different regions of the country, such as fruits, vegetables, meats, and some popular recipes, was obtained from the National Food Survey conducted in 2008–200912 Household Budget Survey. Information on recipe information was obtained mainly from the population-based health survey in the city of São Paulo (ISA-Capital 2008/2009)[13,14].

Common to all countries, the method used to do the R24h interview is standardized and structured in five steps. The flowchart that summarizes the steps and procedures required to use the program is outlined in Figure 1. The following describes in detail each of the five steps, highlighting the peculiarities of the Brazilian version of the program.

STEP 1: GENERAL INFORMATION ON THE STUDY CENTER, INTERVIEWER, INTERVIEWEE AND DAY RECALLED

At this stage, it is necessary to identify the study center and then the interviewer by selecting the information previously entered in the program for the study center and the interviewer. Next, basic questions such as the interviewee's name, sex and date of birth are recorded, as well as questions about the day recalled. The program allows one to record only the last or second to last day prior to the interview date. In addition, it makes it possible to identify whether on the recalled day the individual was on a special diet (e.g., dietary restriction, medical treatment, etc.), or if it was a special day (e.g., celebrations, work, travel, fasting, etc.).

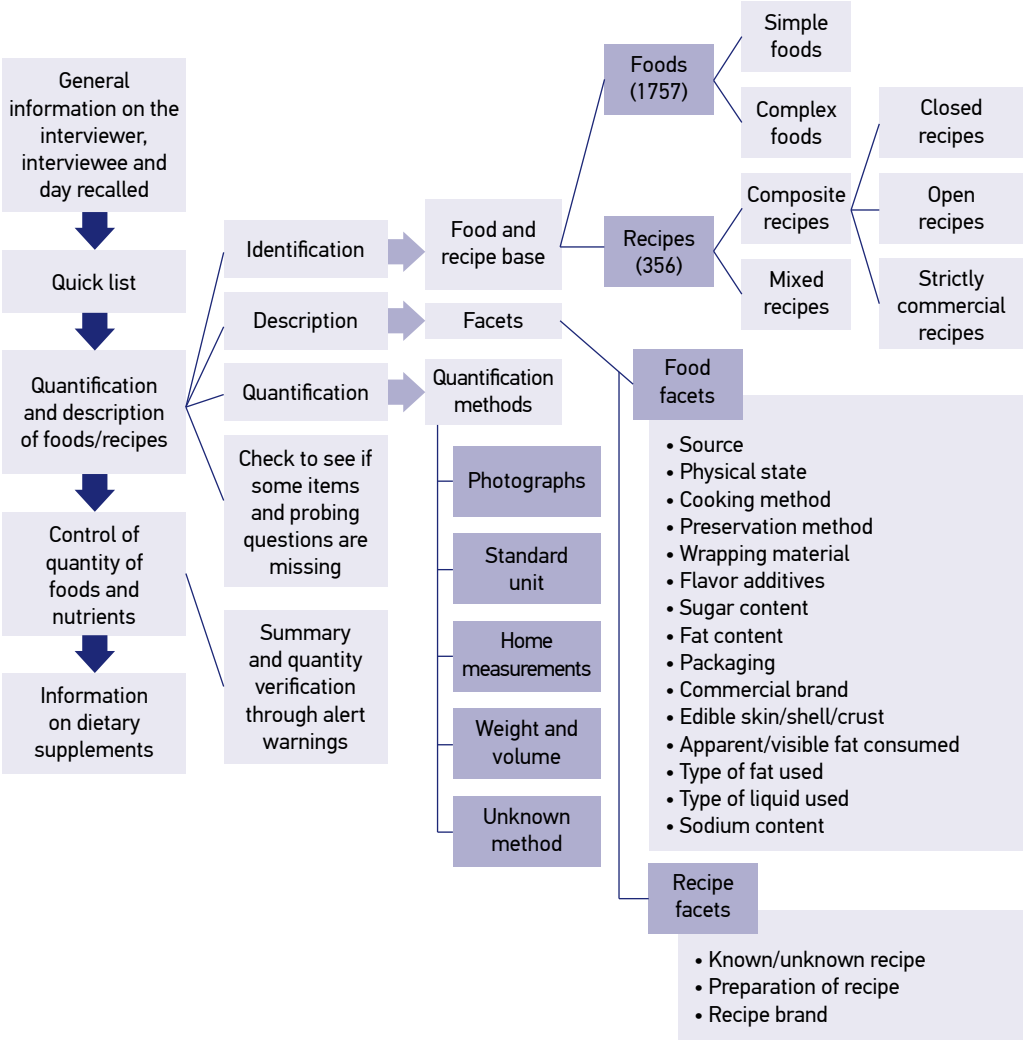

Figure 1. Flowchart of the steps and procedures of the Brazilian version of the software GloboDiet.

STEP 2: QUICK LIST

The quick list notes all foods/recipes consumed by the interviewee following the chronological order of the day. The interview is conducted so that he/she reports his/her consumption at times of food consumption (TOC). The program offers 11 TOC options. For each TOC during the day, the interviewee is asked about the place and time information. The foods consumed are reported according to the interviewee's answer (the so-called quick list), and there is no concern at this time with the description, in detail, or with the quantification of the food/recipes.

STEP 3: IDENTIFICATION, DESCRIPTION AND QUANTIFICATION OF FOOD/RECIPES

In Step 3, each of the items reported in the quick list must be identified, described and quantified. Four main procedures can be distinguished:

- Identification: In GloboDiet, a classification is made considering the distinction between foods (or ingredients) and recipes. Foods can be simple foods (e.g., fruits, vegetables, milk, meat cuts, fish) or complex foods (e.g., cakes, cookies, pasta, desserts, sauces, etc.). Complex foods contain several ingredients but are defined as a single food item and their ingredients cannot be described or quantified separately. Therefore, they are treated the same way as simple foods. Both simple and complex foods can be used as recipe ingredients. The recipes, in turn, are divided into two main groups: compound recipes, which are not previously entered in the program recipe list and will be added to the quick list, and different ingredients (simple or complex foods) can be linked to the recipe (in which case the ingredients may be separately identified and quantified before or after preparation/mixing, e.g., coffee with milk, bread with margarine, lettuce and tomato salad); and mixed recipes, which are present in the program recipe list with certain pre-defined ingredients. The ingredients of these recipes can be classified into two types, fixed or replaceable, and mixed recipes are classified into three types: open, closed or strictly commercial. It is noteworthy that the classification of mixed recipes as open or closed considers whether the ingredients listed in the recipes may vary considerably or not, which will allow the identification, description and quantification of these ingredients. Thus, the recipe classified as open in the program is more flexible when it comes to changing ingredients compared to the closed recipe. To date, 1,757 foods are classified into 18 food groups with 86 subgroups and 50 subsubgroups and 356 recipes, representing the foods and recipes eaten by the Brazilian population. Table 1 shows the distribution of groups, subgroups and subsubgroups, as well as the number of items in each group.
- Description: The description of foods/ingredients and recipes is done through *facets*, terms that represent the characteristics of a food or recipe, for example the

cooking method, sugar and fat content, etc. During the interview, these facets are used as a sequence of questions to be asked of the interviewee to describe the food consumed. For this characterization, a sequence of windows opens with the response options available for each facet, which correspond to the descriptors, which more precisely detail the characteristics of a food/recipe. The definition of the specific facets for foods and recipes present in the Brazilian version of GloboDiet is in Chart 1.

Table 1. Distribution of quantity of subgroups, subsubgroups and items according to food groups in the Brazilian version of the software GloboDiet.

Groups	Quantity		
	Subgroups	Subsubgroups	Items
Potatoes and other tubers	2	-	15
Vegetables	10	-	112
Legumes	2	-	15
Fruits, nuts and seeds, olives	4	-	147
Dairy products and milk substitutes	9	10	111
Cereals and cereal products	6	3	217
Meats, meat products and substitutes	7	13	219
Fish, crustaceans and amphibians	5	-	79
Eggs and egg products	2	-	4
Animal fats and oils	5	-	28
Sugar and confectionery	4	12	125
Cakes and cookies	3	-	188
Non-alcoholic beverages	5	5	83
Alcoholic beverages	7	-	78
Condiments, peppers, sauces and yeast	5	4	201
Soups and broths	3	-	1
Miscellaneous	4	3	25
Salty snacks	3	-	109
Total	86	50	1757

Chart 1. Definitions of facets applied to foods and recipes in the Brazilian version of the software GloboDiet.

Facet	Definition of facets
Foods	
Source	Indicates the source of food and there can be more than one source.
Physical state/form when measured	Physical state or form of food when the quantity to be used/consumed is determined.
Cooking method/ preparation	Describe the cooking method used immediately before consumption. It does not apply to cooking methods used for preservation purposes.
Preservation method	Form in which food was preserved for the short or long term.
Wrapping/ preservation material	Provides information on how the food is ready-made or packaged. This facet will only be proposed when there are descriptors, particularly to be canned.
Flavor additives	Small amount of other food or substance is added to the food for flavoring, completely impregnating the food (or is mixed with the food); it is qualitative information.
Sugar content	Provides information on the intrinsic sugar content of the food. This does not concern the addition of sugar to the food by the interviewee just before eating it; such added sugar should be listed and quantified as a separate ingredient.
Fat content	Provides information on the intrinsic fat content of the food (or type of milk used for some dairy products).
Food production	Helps discriminate foods prepared at home from purchased foods. This facet provides information on where the food was prepared, regardless of whether it was consumed on site or delivered.
Brand/commercial name of product	Provides information on the brand and/or product name of the food.
Edible skin/shell/crust	Provides qualitative information on whether the skin or shell is eaten by the interviewee.
Apparent/visible fat consumed	Provides qualitative information on whether the interviewee ate the fat around the meat cut.
Type of fat used	This qualitative information is especially proposed when the descriptors *homemade/commercial* and *fat used* are known from the food production facet selected for a given food item.
Type of liquid used	This qualitative facet is proposed especially if the food was described as being *reconstituted using powder or diluted using concentrates.*
Sodium content	This qualitative facet is proposed to define the sodium content of the food as normally salted, reduced salt/sodium, dietary product with sodium restriction, or without added salt.

Continue...

Chart 1. Continuation.

Facet	Definition of facets
Recipes	
Known/unknown recipe	It is used to find out if the interviewee knows the recipe (ingredients and quantities), as this will influence how the recipe will be described. In case the interviewee knows the recipe, he will have to provide all the ingredients. If the interviewee does not know the recipe, the recipe will be described and quantified as a part of the entire standard recipe.
Preparation of recipe	It helps to distinguish a recipe prepared at home from a ready-made one. If the recipe is homemade, the interviewee may know the recipe or any of its components (for example, qualitative type of fat used for the preparation). If the recipe is commercial, the interviewee may know the brand name (or product name) of the recipe purchased.
Recipe brand/name of product	It is used to enter information about the brand and/or name of the product in a recipe. The list of default product name/brand is available, but the missing information can be added manually.

- Quantification: Among the different procedures for reporting consumed quantities, the following are available in the Brazilian version of the program: photo quantification (Figure 2), home measurement quantification (Figure 3) and individual portion estimates, considering size and packaging of the food available in the country as standard unit, weight and volume quantification. A photographic manual of food quantification was developed with the main images to be used for food/recipe quantification purposes mentioned during the interview with GloboDiet[15].
- Missing food check: The procedure consists of reviewing the information reported by the interviewee. Thus, the interviewer checks to see if any item is left unreported and points out items usually omitted or forgotten in R24h (e.g., sauces, drinks, spices, etc.). These survey questions were previously related to food/recipes considering the forgetfulness of reporting foods that are generally consumed with other foods. For example, if the interviewee reports pasta, probing questions about sauces and cheese will appear on the program screen.

STEP 4: CONTROL OF QUANTITY OF FOOD AND NUTRIENTS

In this phase, the energy and macronutrient intake, estimated by the R24h of the interview conducted by GloboDiet, is compared with the stipulated energy needs, which were calculated using standardized equations that consider the participant's recorded age, weight, height and sex information. Step 1[16]. If the energy intake or one of the estimated

macronutrient values by R24h is outside the expected range taking into account age, sex, height and weight in the case of energy, and for macronutrients, the contribution as a percentage of total energy according to the reference used in the country, a warning (highlight in red) of too low or too high intake is signaled at the end of the interview.

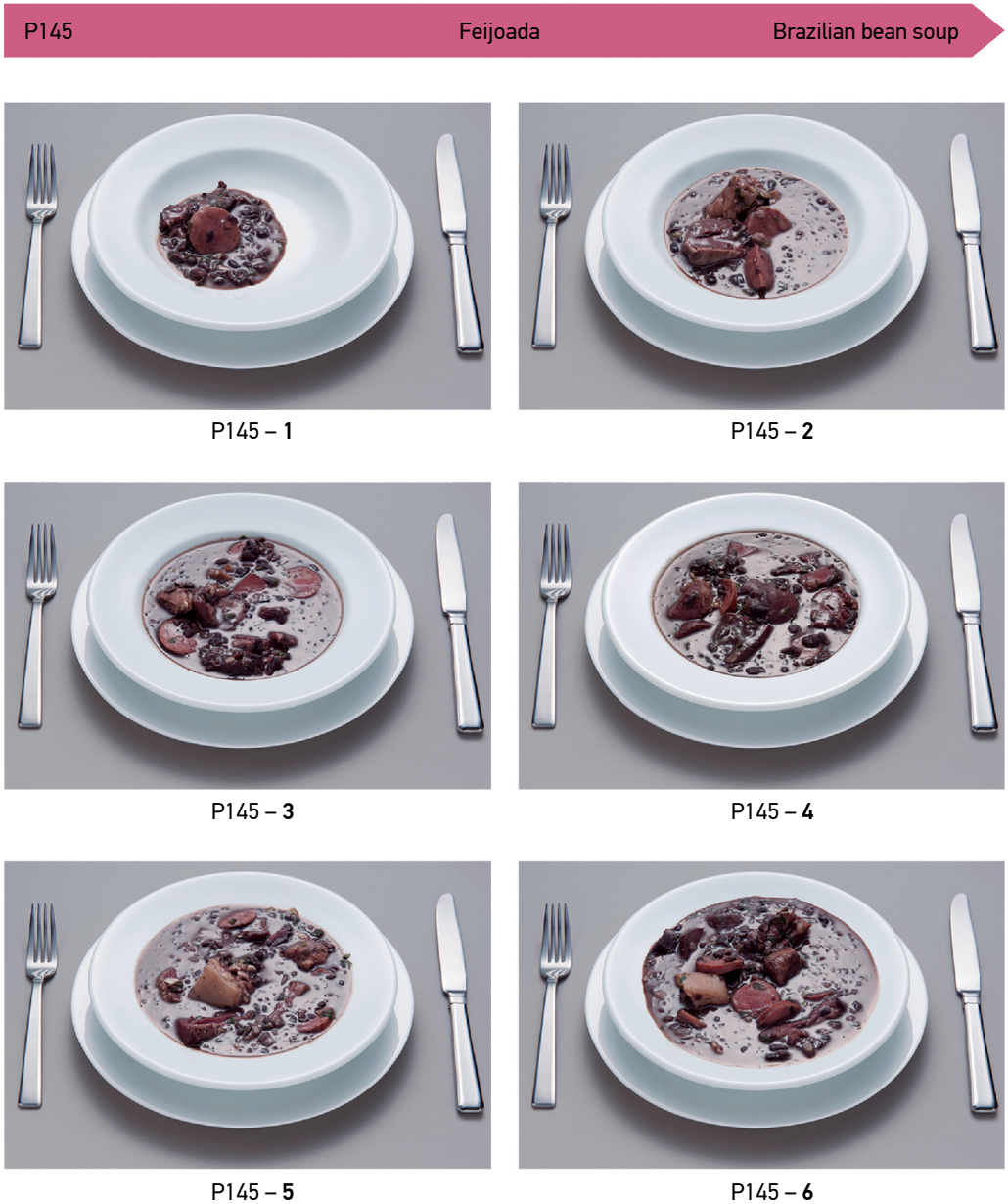

Figure 2. Sample photograph of the recipe *feijoada* in the photographic manual for food quantification used in the Brazilian version of GloboDiet[15].

Figure 3. Sample photograph of home cups from the photographic manual for food quantification in the Brazilian version of GloboDiet[15].

In addition, a specific alert (highlighted in red) about the excessive amount of a given food is also displayed in an attempt to minimize possible quantification errors and allow correction even during the interview. It was understood as an excessive amount when consumption exceeded 1.2 times the largest portion of the photographs or twice the average standard unit of food/recipe.

STEP 5: DIETARY SUPPLEMENT INFORMATION

Information on dietary supplements can be entered throughout the interview, in any TOC during the quick list, or at the end of the interview. In the case of dietary supplements, the corresponding facet refers to the *physical state/form,* which refers to the way the supplement was taken, in drops, sachets, ampules, tablets, etc. In addition, a number of units must be reported to quantify the supplement. There is also a list of home measurements that can be used if the interviewee selects the *liquid* or *powder* option.

PROGRAM FILE MANAGEMENT

The program has two main databases, called *Parameters* and *Interviews*. The first includes all information related to food/recipes present in the program, while the second includes information from participants obtained during the interview. In this way, it is possible to update the parameter database, especially when there is a need to add information on new foods/recipes and changes to existing information. Once a new *Parameters* database is restored in the program, updates are automatically made to the *Interviews* database. Therefore, previously collected interviews will be preserved and only updated with the new data. In addition, the program makes it possible to export files referring to the interview database allowing to obtain a file for retrieving saved information (extension.bak), a file for viewing and editing interviews when necessary (extension.xml), and five archives for building a bank for food consumption analysis (extension.csv).

ACCESS AND USE OF PROGRAM

The program was developed to evaluate food consumption in a standardized way to be used in scientific research and studies on food and nutrition surveillance. IARC is currently the sole owner of GloboDiet, its existing and future updated versions, and all related tools and manuals. Thus, these items, individually or as a whole, called the GloboDiet method, are protected by intellectual property rights and reserved for IARC during and after any study. However, IARC has no ownership of or right to use data obtained from interviews conducted with the GloboDiet method. Thus, on demand and for research purposes, the

program, in its Brazilian version, will be made available to researchers free of charge after training and certification for use.

To enable and facilitate access to interested researchers, an instructional user manual of the Brazilian version of GloboDiet was prepared, which includes all the program's characteristics, as well as recommendations on how to conduct interviews. The manual has been translated from the original GloboDiet program material and adapted to information referring to country-specific databases.

Finally, an explanatory video was prepared, in which the information contained in the instruction manual was summarized[17]. The video contains an example of an interview conducted with the Brazilian version of the program. In this way, it is possible to visualize the program interface and the information filling steps during the interview. In addition, a distance education (DE) course was developed to train, enable and certify researchers and practitioners in the use of the Brazilian version of GloboDiet.

CONSIDERATIONS

GloboDiet is an important tool used for food consumption assessment in Europe. The application and validation of the use of the program have been reported in several studies[18-29]. In Brazil, program validation is already underway through a validation study with recovery biomarkers such as 24-hour urinary nitrogen/potassium excretion biomarkers, and double-labeled water as a measure of energy intake[30].

For the Brazilian version of GloboDiet, researchers will be able to conduct the R24h interview using a standardized road map, which reduces the errors inherent in the collection of information by the interviewer and among the interviewers. The program will also allow the comparison of consumption data from national and international studies, because they use the same data collection methods. Thus, although some foods/recipes are specific, the path taken for detailing (selection, possibilities of description and quantification) the food item up to the final values (grams), which will be related to the composition tables of each country, is standardized, ensuring care in obtaining information.

Regarding the specificities and care with the development of the Brazilian version of the program, the construction of the list of foods and recipes stands out, which included an exhaustive search of both the foods/recipes and their synonyms, considering the food of all regions of the country, in addition to translating the names of these foods/recipes into English, facilitating understanding of and comparison with data from other countries. In addition, the determination and review of the quantification methods considered the home measurements used locally, the choice and photographic record of portions of food/recipes usually eaten by people and the collection of information regarding the standard units of food/recipes sold in the Brazilian market.

LIMITATIONS

The program, in turn, has some limitations, which can be improved in future updates of versions, such as the inclusion of photographs of food/recipes in its programming. Currently, the photograph album is support material shown separately for the interviewee.

In addition, the program does not have the values for nutritional composition of the foods or recipes included in its programming. All calculations for energy, macronutrients, micronutrients and other dietary constituents are performed outside the program, through routines during data analysis using the relationship between the interview database of GloboDiet (data of grams of the interviewee's consumption) and the databases of nutritional composition table available in the country. This process of linking the food consumption and composition databases carried out externally is common in international and national studies on food consumption. However, it is important to assess which nutritional composition table will be adopted in the relationship analyses, since this step is critical in assessing the estimate of nutrient intake.

Accordingly, for the GloboDiet validation study in Brazil, we chose the use of the Brazilian Food Composition Table - University of São Paulo (TBCA – USP), version 6.031, which offers a complete profile of 34 components in more than 3,400 items, including mixed recipes, simple preparations, processed products and fresh foods. Currently, our research group is conducting a study of harmonizing databases of consumption and food composition, to provide a computational algorithm for the systematic connection of the TBCA with the food database of GloboDiet. Subsequently, this algorithm will be available to researchers who use the Brazilian version of GloboDiet.

Another point discussed as a limitation in the use of the program is the time spent to conduct the interview, with an average duration of 31 minutes. Although the time is considered long by some researchers, at the end of the interview, the researcher will already have a database available with the information collected, while in the collection of the R24h on paper, the researcher will have a shorter interview time, when compared to GloboDiet. However, the researcher will need time and resources for subsequent stages of collection, such as standardizing home measurements in weight and volume units, and also entering data into the specific program to obtain nutritional values, which can lead to measurement errors in the data collection and analysis of R24h.

In addition, we will soon publish the results and discussions on the usability of the program and the process of participants in a longitudinal study joining the dietary data collection protocol for R24h using GloboDiet, which may contribute to the design of epidemiological studies with data collection.

CONCLUSIONS

The Brazilian version of GloboDiet may provide a more accurate assessment of food consumption, as observed in other countries that have been using the same program. After the

end of the validation study in Brazil, the Brazilian scientific community will have a platform for collecting short-term, standardized and valid consumption data.

Therefore, it is expected that with these standardized methods, food consumption obtained by the program will be used for the purpose of food and nutrition surveillance and to investigate the relationship of diet with health outcomes. In addition, as several European countries have already developed their versions and as other countries such as North Korea, South Africa and Mexico are developing theirs, the results obtained by the different versions of the program will allow the comparison of food consumption with research carried out in different regions in a global context.

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