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Comparing nutritional value of diets among nutrition software

Comparação de valor nutricional de dietas entre programas de nutrição

Comparación del valor nutricional de las dietas de los programas de nutrición

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Keywords: Nutrients; Software; Observational Study

ABSTRACT

Objective: To compare three nutritional calculation software regarding the agreement of nutritional composition, specifically the total energy of the diet, macro and micronutrients, totalizing 16 nutrients. **Methods:** Observational study that software evaluated were the DietWin Profissional®, Avanutri Online® and the World Food Dietary Assessment System®. Food Recall data from 100 children were used. The normality of the variables were verified using the Kolmogorov-Smirnov test. The results were analyzed using the Friedman and Tukey test, with a confidence level of 5%. **Results:** The nutritional calculations showed significant statistical differences in energy and fifteen nutrients: carbohydrates, proteins, lipids, saturated and monounsaturated fats, cholesterol, fiber, vitamins A, D, E and C, sodium, iron, calcium and zinc ($p<0.05$). The DietWin® program obtained the lowest values for the nutrients analyzed and the WorldFood® showed the highest values. **Conclusion:** The characteristic tables that make up the programs varied significantly in estimating values of nutrients.

Descritores: Nutrientes; Software; Estudo observacional

RESUMO

Objetivo: Comparar três softwares de cálculo nutricional de dietas quanto à concordância da composição nutricional, especificamente do valor energético total da dieta, macro e micronutrientes. **Métodos:** Estudo observacional onde os programas avaliados foram o DietWin Profissional®, Avanutri Online® e o World Food Dietary Assessment System®. Foram utilizados os dados de recordatórios alimentares de 100 crianças. A normalidade das variáveis foi verificada pelo teste de Kolmogorov-Smirnov e para a comparação dos resultados, utilizou-se o teste de Friedman e Tukey, com nível de confiança de 5%. **Resultados:** Obtiveram-se diferenças estatísticas significativas para energia e quinze nutrientes: carboidrato, proteína, lipídeo, gorduras saturada e monoinsaturada, colesterol, fibra, vitaminas A, D, E e C, sódio, ferro, cálcio e zinco ($p<0,05$). O DietWin® foi o programa com os menores valores para os nutrientes analisados e o WorldFood® apresentou os maiores. **Conclusão:** As características das tabelas que compõem os programas variaram significativamente a estimativa de nutrientes ingeridos.

Descriptores: Nutrimentos; Programas Informáticos; Estudio observacional

RESUMEN

Objetivo: Comparar tres software del cálculo nutricional de las dietas ya que el acuerdo de la composición nutricional, específicamente el valor total de energía de la dieta, macro y micronutrientes. **Métodos**: Estudio observacional en los programas evaluados fueron DietWin Profissional®, Avanutri Online ® y World Food Dietary Assessment System®. La recolección de alimentos se utilizó datos de 100 niños. La normalidad de las variables se verificó mediante la prueba de Kolmogorov-Smirnov y la comparación de los resultados, se utilizó el test de Friedman y Tukey, con un nivel de confianza del 5%. **Resultados**: Se obtuvo el cálculo nutricional diferencias estadísticamente significativos de la energía y quince nutrientes: carbohidratos, proteínas, lípidos, saturados y monoinsaturados grasa, colesterol, fibra, vitaminas A, D, E y C, sodio, hierro, calcio y zinc ($p <0,05$). El DietWin® fue el programa que tiene los valores más bajos de los nutrientes analizados y WorldFood® mostró los más altos. **Conclusión**: Teniendo en cuenta las tablas característicos que conforman los programas variaron significativamente en los valores estimados de nutrientes.

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INTRODUCTION

The knowledge of food composition is an important tool for the establishment of health actions, including individual diet prescription, and research on the pattern of food consumption. It is based on the determination of the nutritional content present in the foods eaten, which gives the assessment of dietary intake indicating their suitability or inadequacy[1].

The determination of nutritional composition with nutrition software has been used as a quick and safe way to analyze diets by providing convenience to professionals. Its use has been grounded by the rapid search of information, data storage for future reference, reliability of results when there are no entry errors[2], printed reports, exporting data to other applications and generating patient monitoring charts[3-4].

Brazilian software are the most widespread among Brazilian researchers as well as among professional nutritionists, despite being incomplete in relation to micronutrients. Already international software are more complete in that concern the nutritional composition of foods, but have limitations due to dietary studies for food fortification, variability resulting from genetic and environmental factors involved in the production of these foods and how to prepare and processing[5-6].

In addition, the program differences are due also to the available functions and sources of bibliographic reference, especially in the particularity of food composition tables (FCT)[7]. The tables differ as to the portions used for the dishes' presentation, especially for being standardized in households[8] measures, in addition the portion sizes used are not standardized[9-10]. These points can generate untrusted food consumption evaluation results and show nutritional differences between programs, affecting dietary prescription or assessment of food consumption[7,11].

When considering the small number of studies published in the literature, the lack of comparison between Brazilian and internationals programs and the need to know the differences between programs. This study is proposed to investigate the comparison between the nutritional diet composition obtained by different software to assist in professional choices.

METHODS

The study was observational and the sample consisted of random selection of 24-hour recalls (24hR) of 100 children from two to four years of age, of both genders, who were participants of the main survey. All food recalls were reviewed and the portion sizes were converted to grams or milliliters using standardized tables[12].

In order to collect food consumption data, pairs of interviewers were previously trained and applied a food recall to mothers or guardians to investigate the daily intake of energy and nutrients of the children. The researchers recorded the food name and/or preparation ingested by the child, as well as the quantities in portion sizes and eating schedules. When they were informed more elaborate preparations were requested that ingredients was used to calculate the nutritional value.

The programs used in the study, DietWin Plus® Professional version 2.0 (DietWin®)[13] and the Avanutri Online® (Avanutri®)[14], were chosen because they are well-known and used by clinic nutritionists in Brazil. However, the World Food Dietary Assessment System®[15] program was selected with the purpose of comparing the specifics of an international program with the Brazilian programs, for free distribution and also be used by national researchers.

During the nutritional calculation of the recalls we advocated up an order of priority for use of the FCT. For Avanutri® program, the sequential order was: Philippi[10] table, manufacturer information, and Tabela de Composição dos Alimentos (TACO)[9], only for the baked beans food was used IBGE[16] table. For DietWin®, it was first used to table the program itself (compiled tables: TACO, IBGE, USDA, CENEXA, German Table and General Directory of Food) and later TACO[9]. The tables' order is justified by the greater amount of prepared foods containing adding oil and salt that it had. As for the WorldFood® program, the table used was the "Mexico" because it is the closest table with foods of Brazilian eating pattern.

Prior to entering the software, the portion sizes were converted to grams, then standardized to the corresponding food between programs. For processed foods, information from manufacturers contained on food labels were used, registering the same in the program as possible. For WorldFood®, foods not available were inserted in Mexico database using Microsoft Office Excel®. For Avanutri® due to the impossibility of entering the amount of food in fractional numbers, it performed the rounding of values in a standardized manner in order to minimize errors to compare the data.

The analysis of food consumption including total energy intake was performed (kilocalorie and kilojoules), macronutrients: carbohydrates, lipids, proteins; fibers, lipid fractions (saturated fat, monounsaturated, polyunsaturated and cholesterol) and some micronutrients: vitamins A, C, D and E, and minerals sodium, calcium, iron and zinc.

The data obtained by the three software were processed in duplicate to verify the consistency of typing using the Epi Info® program, version 3.5.1 (2005) and statistical analysis was performed using the Statistical Package for Social Sciences® (SPSS), version 19.0. Initially to normality analysis was performed the Kolmogorov-Smirnov test. A comparison of the results obtained from the programs of nutrients was carried out by Friedman and Tukey test with a confidence level of 5% ($p<0.05$). The choice of non-parametric statistical tests is justified by the non-normal distribution shown by most of the variables under study. For variables with non-normal distribution was calculated median and shows the interquartile ranges.

The main project was approved by the Research Ethics Committee of the Universidade Federal de Goiás (protocol 074/2011) and in charge of all the participants signed the Informed Consent.

RESULTS AND DISCUSSION

As for the comparison between medians of nutrients, WorldFood® program has higher values for Energy (kcal and kJ), protein, carbohydrate, saturated fat and monounsaturated fat, while the lowest values were obtained by DietWin Profissional® program, for the same nutrients, except for the carbohydrate, who presented with lower value for Avanutri Online® (Table 1). With regard to the results of comparison of the level of macro and micro nutrients, statistically significant differences were not found for the median polyunsaturated fat (Table 1).

Regarding the statistical analysis of vitamins, the Avanutri Online® program showed the highest values for vitamin D and E, while the WorldFood® to vitamin C and the DietWin Profissional® to vitamin A. The lower values for vitamins D and E, were observed for WorldFood®, and vitamin C, the DietWin Profissional® program stood out with lower value (Table 2).

Differences are observed in the vitamin A data between the values of 100 recalls calculated by DietWin Profissional®. It was found that the highest values, as far superior to the others, were related to the consumption of carrot accompanied by potatoes or pumpkin, as the carrot is a food source of this vitamin.

For the minerals analyzed except for sodium, all had higher values when evaluated by WorldFood® program. For sodium, the highest value was found in the analysis by DietWin Profissional® program. In addition, the lowest values for calcium and iron were observed for DietWin Profissional® program, as well as sodium, WorldFood® program, and zinc, Avanutri Online® the program (Table 3).

Comparing the two to two programs, significant differences were found for the three analyzes for energy values, protein, lipid, saturated fat and monounsaturated fat, cholesterol, carbohydrate, fiber, vitamins A, D, E and C, and minerals sodium, calcium, iron and zinc, except for polyunsaturated fat.

In the analysis of Avanutri Online® and DietWin Profissional® stands out different values for the following nutrients, protein, lipids, monounsaturated and saturated fat, cholesterol, fiber, vitamins A and D, sodium and zinc. Only the values of protein, lipid, monounsaturated fat and vitamin A were similar when comparing Avanutri Online® and WorldFood®. As for the analysis between DietWin Profissional® and WorldFood®, the values that were found similar to the lipid nutrients and fiber (Tables 1, 2 and 3). When considering the energy and the sixteen nutrients analyzed in this study, the DietWin Profissional® obtained the lowest values for approximately 55% of cases and the WorldFood® program showed the highest values in the same proportion (Figure 1).

At the analysis comparing the nutritional calculation between the three programs, there was a statistically significant difference in energy and fifteen nutrients: protein, lipids, saturated and monounsaturated fats, cholesterol, carbohydrate, fiber, vitamins A, D, E and C, sodium, iron, calcium and zinc ($p<0.05$). The DietWin® was the program that obtained the lowest values for the nutrients analyzed and the WorldFood® showed the

Table 1 - Comparison of median of energy, macronutrient, dietary fiber and lipid fractions obtained from the second analysis of three food consumption calculation programs. Goiania-Goias, 2011-2012. n = 100

Variable	Avanutri Online® Median ($p_{25} - p_{75}$)	DietWin Profissional® Median ($p_{25} - p_{75}$)	Worldfood® Median ($p_{25} - p_{5}$)	p value[1]
Energy (kcal)	1328.8 (1097.3-1669.4)[a]	1416.4 (1081.8-1807.3)[a]	1596.0 (1319.0-1919.2)[b]	< 0.001
Energy (kJ)	5447.9 (4449.1-6844.7)[a]	5807.2 (4435.3-7410.1)[a]	6543.6 (5407.8-7868.7)[b]	< 0.001
Protein (g)	57.5 (47.8-71.9)[a]	54.0 (44.4-69.6)[b]	59.9 (47.2-73.2)[a]	< 0.001
Lipid (g)	41.7 (28.8-60.7)[a]	41.7 (32.8-54.3)[ab]	37.4 (24.2-59.2)[b]	0.032
Satured Fat (g)	14.0 (7.2-22.2)[a]	12.8 (9.7-19.4)[b]	19.0 (14.1-25.2)[c]	< 0.001
Monoinsatured Fat (g)	9.5 (6.6-14.6)[a]	9.1 (6.4-12.2)[b]	10.1 (7.3-16.1)[a]	0.001
Polinsatured Fat (g)	4.8 (3.3-8.4)[a]	5.2 (3.5-8.7)[a]	4.3 (2.1-9.8)[a]	0.090
Cholesterol (mg)	122.4 (66.3-185.5)[a]	103.3 (52.7-150.6)[b]	121.0 (94.7-169.1)[a]	< 0.001
carbohydrate (g)	179.8 (137.1-221.6)[a]	195.7 (156.1-242.1)[b]	246.4 (201.5-296.5)[c]	< 0.001
Fiber (g)	6.7 (4.8-9.8)[a]	13.0 (8.6-18.7)[b]	12.3 (8.4-18.9)[b]	< 0.001

Values are presented as median and interquartile range (p25-p75) .1 Test of Friedman. The medians with the same superscript letters in the same line do not differ significantly (Tukey test, 5% probability).

Table 2 - Comparison of median of vitamins (A, D, E and C) obtained from analysis according to three food consumption calculation programs. Goiania-Goias, 2011-2012. n = 100

Variable	Avanutri Online® Median ($p_{25} - p_{75}$)	DietWin Profissional® Median ($p_{25} - p_{75}$)	Worldfood® Median ($p_{25} - p_{75}$)	p value[1]
Vitamin A (RE)	350.6 (180.9-664.9)[a]	734.8 (84.8-1281.2)[b]	412.0 (229.0-805.0)[c]	< 0.001
Vitamin D (mcg)	8.6 (3.2-124.2)[a]	5.1 (1.94-10.7)[b]	0.6 (0.00-5.2)[c]	< 0.001
Vitamin E (TE)	7.7 (4.9-13.7)[a]	7.7 (4.9-12.8)[a]	1.9 (0.0-4.2)[b]	< 0.001
Vitamin C (mg)	61.3 (25.4-112.6)[a]	58.2 (27.85-108.2)[a]	95.2 (32.70-170.2)[b]	0.007

Values are presented as median and interquartile range (p25-p75). 1 Test of Friedman. The medians with the same superscript letters when in the same line do not differ significantly from each other (Tukey test, 5% probability)

Table 3 - Comparison of medians of minerals (Sodium, Calcium, Iron and Zinc) obtained from analysis according to three food consumption calculation programs. Goiania-Goias, 2011-2012. n = 100

Variable	Avanutri Online® Median ($p_{25} – p_{75}$)	DietWin Profissional® Median ($p_{25} – p_{75}$)	Worldfood® Median ($p_{25} – p_{75}$)	p value[1]
Sodium (mg)	1098.8 (762.1-1467.6)[a]	1514.3 (1037.8-2074.2)[b]	818.0 (542.8-1278.0)[c]	< 0.001
Calcium (mg)	758.3 (489.2-1118.0)[a]	819.2 (455.6-1176.3)[a]	920.7 (542.3-1268.4)[b]	0.034
Iron (mg)	9.2 (6.1-14.7)[a]	9.3 (5.1-15.5)[a]	12.2 (7.6-21.3)[b]	< 0.001
Zinc (mg)	5.9 (3.8-9.4)[a]	8.3 (5.7-12.8)[b]	9.70 (7.0-13.3)[c]	< 0.001

Values are presented as median and interquartile range (p25-p75). 1 Test of Friedman. The medians with the same superscript letters when in the same line do not differ significantly from each other (Tukey test, 5% probability).

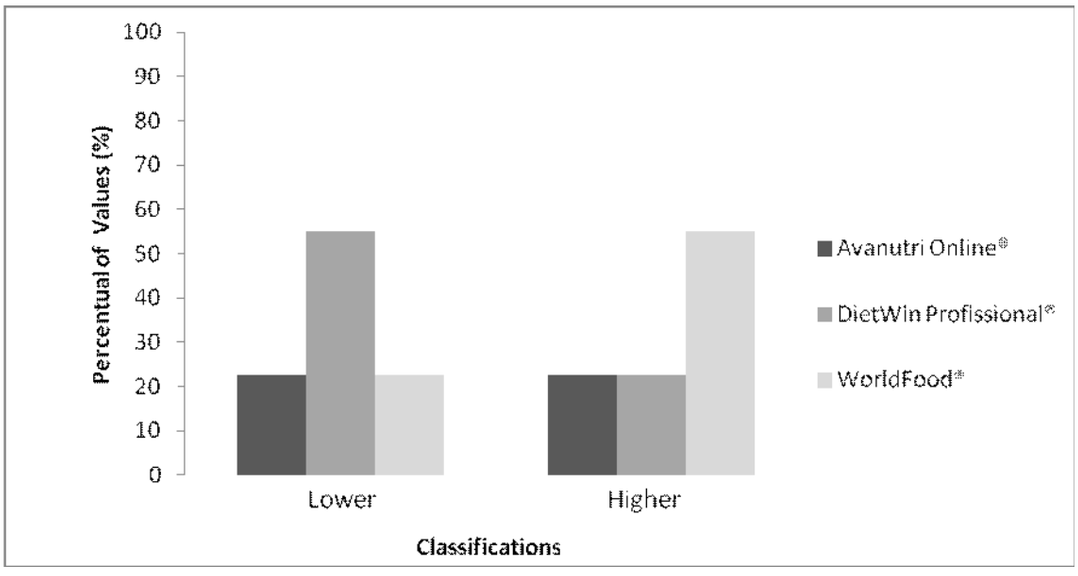

Figure 1 - Distribution in percentage values of energy and medians' nutrients. Goiânia-Goiás, 2011-2012. n = 100

highest values.

In analysis of four international nutritional analysis software calculating differences were also found in the energy values macronutrient, vitamin C and sodium, when performing the comparison of nutrient intake data calculated from 60 24hR[17]. A similar result was found in a study comparison of two diet analysis programs through food nutrients calculation obtained in R24h for energy and macronutrients, except for the carbohydrate. While micronutrient statistical differences were observed only in the iron values[18].

On the other hand, some studies showed no significant differences for energy and macronutrient values obtained for three or four diets calculation programs[7,19-20]. However, for the medians of lipid fractions, only the study Vieira et al (2009)[7] had statistically significant differences between the programs used for analysis of ten menus. By comparing the Brazilian programs yielded statistically significant differences between the two software analyzed in this study. However, when comparing the international program with national program, it appears most prevalent differences considering all the nutrients, whether in comparing each Brazilian or the combination of national programs with the international software.

Few Brazilian studies were performed considering the comparison of computer programs of national and international dietary calculation. In an analysis that compares data of food consumption of twenty people, including Swedish and Finnish program, significant differences were shown for the values of protein, monounsaturated fat, polyunsaturated fat, zinc, calcium, iron and sódio[21]. Vaask and colleagues (2004)[22] compared the two countries database from food consumption obtained from 32 24hR, and noted that programs differ statistically between them in the values of energy, total fat, carbohydrate and calcium.

Also Lee Rainwater Nieman (1995)[3] compared 8 programs used to analysis food intake and the author used as reference the table from the United States Department of Agriculture (USDA). The results show the variation of fiber values, fatty acids, cholesterol and vitamin E compared to the reference database. As for the results of an analysis of 36 menus calculation, through four programs in the United States, compared with the laboratory chemical analysis of these menus, significant differences were found for total energy, lipid fractions, carbohydrate, calcium, potassium, and magnesium sódio[23].

The hypothesis that justify the differences found are the variability of nutrients in the database; the inability of laboratory analysis of all foods due to technical who spend most cost; lack of nutrient data; the choice of food to be considered in the programs; to errors in collection, storage, and handling of samples of chemical analysis. Although they have taken steps to avoid them, these are shown important and can influence the eating plan or the

analysis of meal plans[23].

The differences between the programs databases assessed in this study and other studies may be explained by the fact that the nutrient levels vary according to geographical location, to consider growing conditions, environment, harvest and preparation methods and analysis of food present in FCT[24]. In this context, it is also consider including fortified foods in foreign tables, and we suggest this as an explanation for the higher values for vitamins and minerals obtained by Worldfood® program.

Furthermore, it is known that one of the factors that contribute to erroneous estimation of nutrients are errors in the conversion measured in grams of cooked food, as well as accuracy in collecting data[25]. In this study, standardized measures were adopted both in data collection, with the researchers training, as the calculation procedure, where the order of priority use of composition tables was set, and the preparation of list of foods to be considered more elaborate preparations to remove misalignment during analysis of the recalls.

Another important issue that can affect the calculation of nutrient intake is the lack of cooked food, and it may overestimate the amount considering that the suffering this process of cooking, the food loses some nutrients, such as vitamins. Moreover, in this process the food loses water and can concentrate the content of other nutrients. In WorldFood® program, as it is not presented in the form of food preparation, may have contributed to higher nutrient values in the calculation and affected the composition of fats considering that other programs (Avanutri® and DietWin®) has in its composition food already fried. Thus appears as an alternative to explain the statistical differences between the study of lipid programs.

A challenge for developers of these diets calculation software is the constant changes in the composition of processed foods, thus, serving updated periodically to avoid errors of the estimated intake nutrients. The absence of data entry in grams for some foods, such as rice, Avanutri Online® the program, may also have enabled the differences between the programs overestimated values. In this case, you could only add rice to calculations by the household measures available that have an equivalent value in standard grams each, and often the weight obtained was not exactly the same, but an approximation.

Another interesting factor to be discussed in relation to Avanutri Online® is that it does not allow the input fractional values. In this case, the value was rounded which may have contributed to the differences between the programs. However, this fact did not affect the result. It was also found in the evaluation of this program that the fiber values do not correspond to the actual values of this nutrient. This fact then contributed to the erroneous calculation of the amount of fiber contained in all reminders valued at Avanutri Online®, highlighting the significant difference with lower values than the other analyzed programs.

In summary, when comparing energy and macronutrients medians the Avanutri Online® obtained the lowest values for energy and fiber, while the DietWin Profissional® for protein, saturated fat and monounsaturated fat and cholesterol. The Worldfood®, for having food in its raw form obtained the lowest median values for lipids. As for the higher values of medians, the Avanutri Online® presented himself for lipid and cholesterol, DietWin Profissional® for just the fiber and the Worldfood® for energy, protein, saturated fat and monounsaturated.

Regarding vitamins analyzed, the DietWin Profissional® had the lowest value for vitamin C while the Worldfood® for vitamins D and E. The highest values for vitamin D were observed by Avanutri Online® and vitamin C by Worldfood®. For vitamin E the median found was the same (7.7) for both Avanutri Online® as to DietWin Profissional®.

Finally, the analysis of minerals, the medians with lower values for calcium, iron and zinc were at Avanutri Online® and sodium by Worldfood®. What about the higher values, the Worldfood® introduced himself to the minerals calcium, iron and zinc and DietWin Profissional® for sodium.

CONCLUSION

Analyzing the correlation between the nutritional composition of diets evaluated three software, it found that programs were not in agreement with the largest differences were found between Brazilian and American programs. This is due to the particularity of tables that make up the programs, since these foods have both in raw form as the American program, as for culinary preparations, and in Brazilian programs. This divergence and others as lack of standardized portion sizes in Brazil, lack of standardization in the percentage of fat in food preparation, suggest that the differences can interfere significantly in the estimation of nutrients in food consumption in individual or population level.

Knowing the correlation between nutritional software shows to be relevant for clinical practice in that it allows the choice of the one who most identify with the professional and their patients in nutritional calculation. The precise determination of the estimate of nutrients is also important action for large studies of food consumption aimed at eliminating bias both in determining the nutrient intake by the population as in the determination of food nutrient content.

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