Macronutrient Intake Assessment under Sports Intervention

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Abstract: The objective of this article was to determine macronutrient intake using two methods; 24 hour food recalls (24hR) and 3-day food records (3dFR). The second objective was to calculate macronutrient intake by hand and compare results to those obtained using specialized software. It was hypothesized that macronutrient intake estimates using the two methods would be similar (24hFR vs 3dFR), however the way the food records were analyzed would show different results (hand vs software). These hypotheses will be tested by comparing results obtained by 24hFR and 3dFR, as well as results from Food Processor and gram calculations by hand using computer spreadsheets.

In order to get the result as we expect, we assigned students in the lab completed 3dFRs. Briefly, consumption of all food, beverages and supplements were recorded for three consecutive days, including specifics such as portion size and brand name. Students were instructed to include 1 weekend day in the 3dFR. During the lab, students were paired up, or placed into a group of three, and performed the 24hR with each other, as well as analyzing the 3dFRs of the other student. The 24hR included all food and beverage consumed from midnight to midnight on the previous day and was performed as described in the Laboratory Manual.

Methods

Hand calculations were performed by looking up and recording the gram amount of protein, carbohydrates, fat and dietary fibre of each food listed in the 24hR. Food composition data was obtained from the USDA Nutrient Data Laboratory website and food labels, and data was compiled using Microsoft Excel spreadsheets. Gram amounts for each macronutrient were totaled and % of energy intake was calculated using 4 kcal/g for protein and carbohydrate, and 9 kcal/g for fat as shown below. Fibre was assumed to be 0 kcal/g.

_____ g protein x 4 kcal/g = _____ % of daily energy intake from protein

The foods listed from in the 24hR and 3dFR were analyzed using the nutritional software Food Processor SQL to obtain average daily intake of protein, carbohydrate, fat as a % of total energy intake, as well as in grams (including dietary fibre).

These results were compared to the Estimated Average Intake (EAR), Recommended Dietary Allowance (RDA), Adequate Intake (AI) where applicable (for gram amounts) and to Acceptable Macronutrient Distribution Range (AMDR) (for % energy). Protein requirements were calculated using body weight and the reference values of 0.66 g/kg for EAR and 0.8 g/kg for RDA for women 18 to 30 years of age as shown:

EAR = ___ kg x 0.66 g/kg = ___ g protein

RDA = ___ kg x 0.8 g/kg = ___ g protein

Results

Table 1 Average Daily Intake of Macronutrients Analyzed Using a Nutritional Software Program Versus Calculations by Hand.

Method	Nutritional Software Program							Hand Calculations						
Macro-nutrient	CHO		Protein		Fat		DF	CHO		Protein		Fat		DF
Units of Measure	g	% TK	g	% TK	g	% TK	g	g	% TK	g	% TK	g	% TK	g
Subject 1	341	53	80	12	101	35	48	348	49	80	13	101	38	47
Subject 2	368	65	85	15	51	20	36	366	65	94	17	45	18	35
Subject 3	326	61	60	11	71	28	19	326	60	60	11	71	29	19

CHO: Carbohydrate; DF: Dietary Fiber; %TK: % of Total Kcalorie Intake. The subjects were Nutrition 301 students (n=3 Females). Subject 1 is 23 years old with a mass of 70 kg, Subject 2 is 19 years old with a mass of 50 Kg, and Subject 3 is 19 years old with a mass of 66.5kg. A 24 hour recall of dietary intake was conducted on each subject and their macronutrient intakes were analyzed via hand calculations and a nutritional software program.

Table 2 Average Daily Intake of Macronutrients as Assessed by a 3-Day Food Record Versus a 24 Hour Recall.

Method	3 Day Food Record Average							24 Hour Recall						
Macro-Nutrient	CHO		Protein		Fat		DF	CHO		Protein		Fat		DF
Units of Measure	g	% TK	g	% TK	g	% TK	g	g	% TK	g	% TK	g	% TK	g
Subject 1	323	54	99	16	80	30	40	341	53	80	12	101	35	48
Subject 2	319	68	73	16	34	16	36	368	65	85	15	51	20	36
Subject 3	278	57	92	19	51	24	13	326	61	60	11	71	28	19

CHO: Carbohydrate; DF: Dietary Fiber; %TK: % of Total Kcalorie Intake. The subjects were Nutrition 301 students (n=3 Females). Subject 1 is 23 years old with a mass of 70 kg, Subject 2 is 19 years old with a mass of 50 Kg, and Subject 3 is 19 years old with a mass of 66.5 kg. Each subject recorded their food intake for three days, and a 24 hour recall was also conducted on each subject. The nutritional software program used to analyze macronutrient intake for both methods was Food Processor.

Daily macronutrient intakes from the 24hR method, determined via hand calculations versus nutritional software analysis varied at most by 2% of gram weight (Table 1). However, a comparison between daily nutrient intakes for the 3dFR and 24hR methods revealed greater discrepancies (Table 2). Carbohydrate intake from the 24hR method was consistently higher across subjects when compared to the 3dFR method (Table 2). Subjects 1 and 3 had higher intakes of fat,

dietary fiber and % total Kcalories from fat in the 24hR method (Table 2). Subject 2 also had a higher intake of protein and fat in the 24hR when compared to the 3dFR average (Table 2).

Discussion

When 3dFR averages were assessed for nutritional adequacy, carbohydrate intake was above the Recommended Dietary Allowance (RDA) of 130 g[1] for all three subjects (Table 2). The RDA for protein intake was determined individually for each subject, based on weight, and intakes for all three subjects met or exceeded the RDA (Table 2). Macronutrient intakes from 3dFR averages for all three subjects were also compared to the Acceptable Macronutrient Distribution Ranges (AMDR). The AMDR for carbohydrate, protein and fat are 45-65%, 10-35%, and 20-35% respectively[1]. Subjects 1 and 3 were within the distribution range for carbohydrate intake, while subject 2 exceeded the carbohydrate AMDR for her Kcalorie intake. All three subjects were within the AMDR for protein, and subjects 1 and 3 met the AMDR for fat, whereas subject 2 was under the AMDR for fat (Table 2). Dietary fiber intake of all three subjects was compared to the AI for dietary fiber of 25 g/day[1]. Subjects 1 and 2 exceeded the AI for fiber, while subject 3 did not meet the AI (Table 2). A change that Subject 2 can make in her diet to provide better nutrition is to reduce carbohydrate intake and increase fat intake, preferably with healthy fats found in nuts and fatty fish. Subject 3 can benefit from increasing her dietary fiber intake by consuming more whole grains, legumes, vegetables, and fruits.

When comparing calculation methods for the 24hR method, there was little to no variation between macronutrient intake obtained via the nutritional software program and hand calculations. A possible reason for this is food composition data from the nutritional software program was used for hand calculations for Subjects 1 and 3, while the United States Department of Agriculture (USDA) food composition data was used for subject 2 in determining the gram weight and % total Kcalorie intake for each macronutrient. The use of nutritional software food composition data in hand calculations for two of the subjects may have exaggerated the similarity of intakes between the two analysis methods, because the same food data was used as part of the software calculation.

There was a greater difference in macronutrient and fiber intakes when 3dFR averages and 24hRs were compared. Despite the fact that both are quantitative methods for assessing macronutrient intake[1], there are several possible explanations for this discrepancy. Averages for 3dFRs may have been a better representation of typical food intake in subjects than the 24hRs performed, because the 3dFR average took into account three days, as opposed to one. It is possible that subjects had very different eating patterns the day prior to the 24hR than the three days during which food records were kept; three days are more likely to capture typical food intake. To obtain a more accurate representation of typical dietary nutrient intakes, keeping a food record for 3 to 7 days is ideal[1]. However, deviation from typical food intake can still occur with a 3dFR. For example, subject 3 ate outside the home with greater frequency than her typical food consumption patterns, and subject 1 was ill during the three day record period. This may have affected the 3dFR average for both subjects. Individuals may also alter their typical food intake while keeping a food record, which can compromise accuracy as well. This may explain why subject 2 had a lower total Kcalorie intake when assessed with the 3dFR as compared to the 24hR. Food records also place a larger burden on the subject and require the subject to be literate; although literacy was not an obstacle for the three subjects, a certain level of commitment was required to record all foods consumed for three days. In contrast, the 24hR is a faster method of assessing nutrient intake, with minimal burden to the respondent, however it requires that the individual performing the interview is skilled in asking detailed, non-judgmental questions[1]. The interviewers conducting 24hRs in this study were still familiarizing themselves with the interview process and this may have affected macronutrient analysis. The 24hR method also relies heavily on memory for foods eaten as well as portion sizes from the previous day, and as such may not be as accurate as a 3dFR, where the individual has the opportunity to look at labels and record food intake in real time[1]. Under- reporting food intake is sometimes seen with both methods, particularly if the individual is female or obese[1]. Another

challenge with both methods is that the subject may have difficulty in estimating or measuring portion sizes.

There are also limitations to using a nutritional software program, due to the fact that there is a set list of foods one must select from when inputting data, whether a food record or a 24hR approach is used. As a result, it was not always possible to find the exact foods an individual had consumed via the software program, particularly for uncommon or ethnic foods, and this may have skewed macronutrient intake data.

Conclusion

Contrary to the hypothesis, results using the two methods (records vs recall) to estimate macronutrient intake revealed greater differences, whereas the comparison between analyses of the food records (software vs hand) resulted in little difference in intakes of carbohydrate, protein and fat. Because adequacy of intake is based on an estimate of "usual" intake, the sources of error need to be considered when using DRIs to make these conclusions. There are various personal and contextual factors that can influence food consumption patterns and collection of data. As such, nutrient deficiency or excess, as well as disease risk cannot be concluded strictly from the two methods discussed, and further biochemical tests are needed for a more accurate clinical assessment.

References

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