COMPARISON BETWEEN 2 DIFFERENT DIETARY INTAKE METHODS (7-DAY DIETARY WEIGHT RECORDS AND 24-HOUR DIETARY RECALL) AND DUPLICATE DIET METHOD RESULTS WITH REFERENCE NUTRIENT INTAKE (RNI)

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ABSTRACT

Background

Dietary intake assessment methods have an important role in evaluating dietary intake. Choosing the appropriate one is a big challenge as no particular one of them is appropriately designed to give 100% accurate results. The 7-day weighed records are regarded as the gold standard method, results are more accurate when comparing them with energy expenditure measurement of doubly labeled water (DLW) and urinary nitrogen excretion. On the other hand, 24-hour dietary recall is regarded as an easy and non-expensive method but memory dependable.

Objectives

Comparing two dietary intake assessment methods, 7-day weighed record, and 24-hour dietary recall in terms of nutrient intake, looking at the cons and pros of each and finding the correlation between them.

Methods

Twenty-four-hour dietary recall was taken through an interview between a couple of subjects, the interviewer asked details questions about food intake and portion size of the subject`s last 24 hours then each exchanged their role. Regarding 7-day dietary weighed records, a weight scale was used by the subjects to weigh every food before consumption for 7 days. Also, duplicate diet energy contents were calculated through some complex chemical procedures.

Results

Results showed a strong correlation in carbohydrate, protein, fiber & iron intake of both methods (P. <0.05), however correlation of energy, fat & calcium were not statistically significant between the two methods (P. >0.05).

Conclusion

No method is the perfect one and more studies are necessary to make dietary intake assessment methods more accurate and effective.

Keywords: *7-day weighed record; 24-hour dietary recall; Reference nutrient intake; Duplicate diet method.*

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INTRODUCTION

Nutritional assessment is one of the specific attention of nutritionists; it uses several methods to assess nutritional wellbeing, including anthropometric measurements, biochemical analysis, clinical and dietary assessment, this report focuses on the dietary aspect of nutritional assessment [1].

Despite the availability of several methods, dietary assessment is very challenging and none of the methods is perfect 100%.

Dietary assessment can be done on a national, group, and individual basis; data are collected either on community or individual foundations.

Population data are used for surveillance, comparing intake to reference nutrient intake (RNI), making health policies, and finding the relationship between particular health issues and diet [2].

Population data mostly depend on households, not individuals, and might reflect socioeconomic and regional differences. Food balance sheets collect data from produced food, importation & exportation with food wastage calculation, through this information, for example, The Food & Cultural Organization (FAO) of the United Nations tries to find links between bowel cancer and meat consumption.

In the household records method, all food that enters the house is recorded for one week and divided on the number of house residents, recently food eaten outside the house is considered too, National Food Survey in the United Kingdom uses this approach for more than 50 years. A drawback of the two mentioned methods is no relation between nutritional intake and diseases are made on bases of difference in age and sex.

However, normally 24-hour recall is preferred in national nutritional surveys assuming a fair estimation of the average intake of the population [2, 3].

On an individual basis, there are different methods used which can be classified as retrospective & prospective or subjective report and objective observation.

In 24-hour recall, the trained interviewer asks the subject about food intake in the previous day, this can be through several stages and takes around 30 minutes. Dietary record is another method that subjects record in detail the amount of food consumed for 1-7 days. Also, the Food frequency questionnaire (FFQ) is a subjective method, which looks at food groups eaten in a time, a checklist of 100-150 foods is mostly used and takes around 20-30 minutes. The dietary history method tries to evaluate dietary intake over a longer period, usually one month and takes a long time (around 90 min.).

The most reliable method is the weighed food record method, the subject is told to weigh all foods and drinks consumed during a particular time, usually 7 days [4]. Furthermore, the dietary assessment helps in the diagnosis & management of malnutrition (both under-nutrition & over-nutrition), at the individual & community level alongside other mentioned assessments [5]. On the national level, information taken over some time can be used for monitoring population or sub-population groups at risk of a particular nutritional problem, dietary diversity, planning fortification programs, setting appropriate intervention, and checking the progression of programs [6, 7].

Choosing the appropriate method depends mainly on the level of the objective of the study, and the length of time needed, or the number of replicated days depends on the availability of nutrients of interest in daily food consumption and the purpose of the nutritional assessment. A study by Nelson showed that recording diet over a short, separate period's day is favorable for assessment of micronutrient like iron, zinc, nicotinic acid & pyridoxine while dietary history & FFQ are more appropriate for cupper, retinol, Vitamin B-12, carotene & alcohol [1, 8].

Also, subject`s varieties and their response should be kept in mind, for example, methods depending on memory might not be proper for elderly or illiterate people who are not able to answer FFQ.

Availability of resources and cost-effectiveness is again important to consider, some methods need trained personals, advanced technology, and sophisticated laboratory facilities, which means more money expenditure. [6]

Understanding and decreasing random & systemic errors is also crucial when performing the dietary assessment, these include nonresponse bias, over or underreporting food intake, subject`s memorization problem, the bias in portion size coding bias & interviewer`s bias. [6]

Objectives

A compression between 7-day weighed record & 24-hour dietary recall, showing advantages &

disadvantages of both, using duplicate diet method for measuring dietary intake and comparing all the methods with reference nutrient intake (RNI).

METHODS

Twenty-four-hour dietary recall was taken through an interview between two of subjects, the interviewer asked detailed questions about food intake and portion size of the subject`s last 24 hour then each exchanged their role. Interviews took nearly 15 minutes for each one. Later food portion sizes were changed to estimated grams for each food and the Diet plan seven programs were used to calculate energy, macronutrients, and some trace elements from the recall. Some food types were not available on the program and alternatives foods were entered in the program.

Regarding the 7-day dietary weighed record, the university provided subjects with an accurate weight scale (Digital Kitchen Scale Food Scale) to use for the 7-day weighing. Before the application, participants were thoroughly instructed about the mentioned method and how to practice it. During the one week, every consumed food was weighed before consumption, even though it was a difficult issue to be done. The scale was used at home, fast food places, and restaurants. The accuracy of weighing parts of some particular foods was in hurry sometimes, however, the best possible practice was tried. A trial version of diet plan seven application was used to extract contents of the consumed diet during the entire 7 days. Again, some recipes were not put on the program and available alternatives were used instead.

A duplicate diet was used in this report as a third dietary intake assessment method. Again, for 24 hours each subject collected an exact sample of consumed food and drinks except water in a container before mixing it to a homogenized mix using 100 ml. distal water and a special blender at the university`s laboratory. Then a sample was dried in the oven for several days before crushing it to a fine powder.

Different methods were used to determine samples' nutrient content. Kjeltec method which is a standard for determining protein was used, by using concentrated H2SO4 & inorganic salt catalysts all sample`s nitrogen was converted to NH4 before it made alkaline and ammonia steam distilled into B(OH)3, then its tittered against 0.1 M HCL.

For energy estimation, 'Isoperibol' bomb calorimetry was used, a food sample is burned electrically inside a closed chamber, the produced heat flows into a known volume of water and the temperature increase is measured.

Soxtec procedure was used to determine the fat composition of the dried sample that was continuously washed by the solvent.

Finally, for each method, a special calculation was done.

IBM SPSS 22 for mac has been used for statistical analysis of the provided data through several analytic processes.

RESULTS

There is no significant correlation between nutritional assessment methods. (R=0.491(16), P=0.053) in the mean and standard deviation of energy intake from both 7 days dietary weighed record and 24-hour recall (table 4 & Scattered plot 1)

Table 5 & Figure 2-4 show differences in mean & standard deviation of macronutrient intake between both 7-day dietary records & 24-hour recall. There is a significant correlation between protein and carbohydrate (CHO), R=0.797(16), P<0.05, and R=0.791(16), P<0.05 respectively. However, fat intake is not significantly different when analyzing data from both dietary assessment methods for these particular subjects. R=0.382(16), P=0.144.

The three scattered plot charts show the comparison of intake of three macronutrients in both methods used.

Table number 6 shows the mean and standard deviation for Fiber, Iron & Calcium intake according to both 7-day weighed records and 24-hour food recall. There is positively significant correlation for both fiber & Iron, r=0.745(16), P=0.001 & R=0.518 (16), P=0.040 respectively. However, data for Calcium intake do not correlate between both dietary assessment methods, r=0.453 (16), P=0.078.

Table seven compares energy, protein, iron, and calcium intake from both methods with Reference Nutrient Intake (RNI) for females. It seems that Energy, protein

& calcium intake is higher than the mean recommended by RNI, however iron intake is slightly lower than recommended.

On the male side, while energy intake seems a bit under RNI recommendations, however protein, iron, and calcium consumption are higher than RNI means. The details are demonstrated in table 8.

Table 9 compares three nutrient intake results from duplicate diet method of a subject to RNI recommendation for that particular age and sex.

Table 1. Numbers of participants and gender percentage, females were more in comparison to males.

Category	Number of participants	Percentage
Total	16	100%
Male	7	43.8%
Female	9	56.3%

Table 2. Average and standard deviation for (age, height, weight, BMI) of female subjects.

Category	Minimum	Maximum	Mean	Std. Deviation
Age	21	35	29	5.3
Height (cm)	156	179	165.2	7.5
Weight (kg)	53.0	89.0	62.3	11
BMI (kg/m²)	19.5	31.5	22.7	3.7

Table 3. Average and standard deviation for (age, height, weight, BMI) of male subjects.

Category	Minimum	Maximum	Mean	Std. Deviation
Age	25	36	29	4
Height (cm)	164	179	171.1	6.1
Weight (kg)	63.1	74.8	67.02	4.04
BMI (kg/m²)	20.2	26.5	22.8	1.9

Table 4. Mean and standard deviation of energy intake from both methods.

Energy intake from dietary assessment	Minimum	Maximum	Mean	Std. Deviation	Spearman rho correlation
Energy (Cal) 7-day weighed a record	789	3396	1934.9	658.5	Coefficient Correlation: 0.491
Energy (Cal) 24 –hour recall	882	2989	2013	635.4	Sig. (2-tailed): 0.053

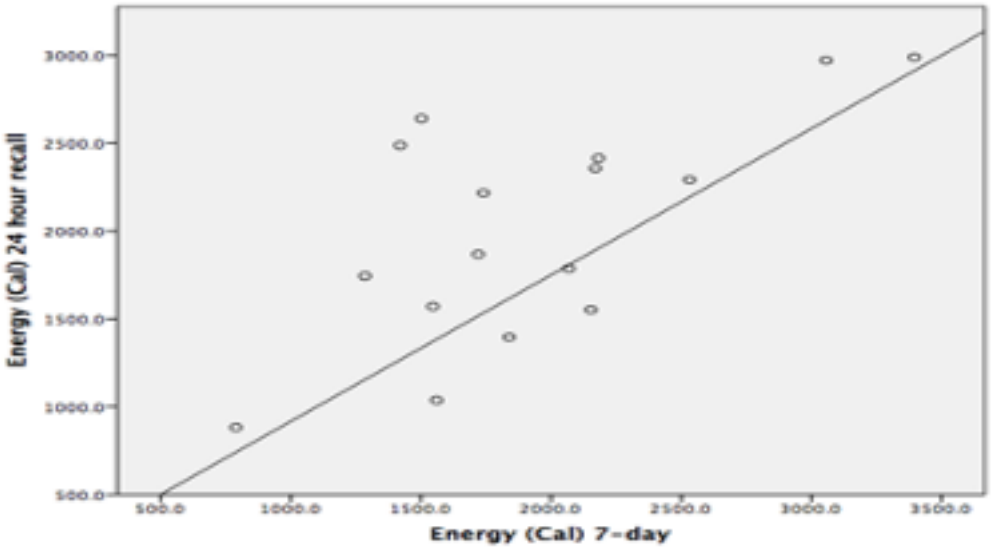

Figure 1. Correlation between energy intake from 7-day dietary record & 24-hour recall.

Table 5 Differences in mean & standard deviation of macronutrients intake between both 7-day dietary record & 24-hour recall.

Intake from dietary assessment	Minimum	Maximum	Mean	Std. Deviation	Spearman`s rho correlation
Protein (g) 7-day	38.6	179.8	88.03	41	Coefficient Correlation: 0.797
Protein (g) 24-hour recall	28.0	278.0	90.3	65	Sig. (2-tailed): 0.000
CHO (g) 7-day	97.4	495.0	228.03	107.1	Coefficient Correlation: 0.791
CHO (g) 24-hour recall	120.1	448.4	253.6	99.9	Sig. (2-tailed): 0.000
Fat (g) 7-days	21.8	130.8	77.3	29.3	Coefficient Correlation: 0.382
Fat (g) 24-hour recall	25.5	152.4	76.1	32.6	Sig. (2-tailed): 0.144

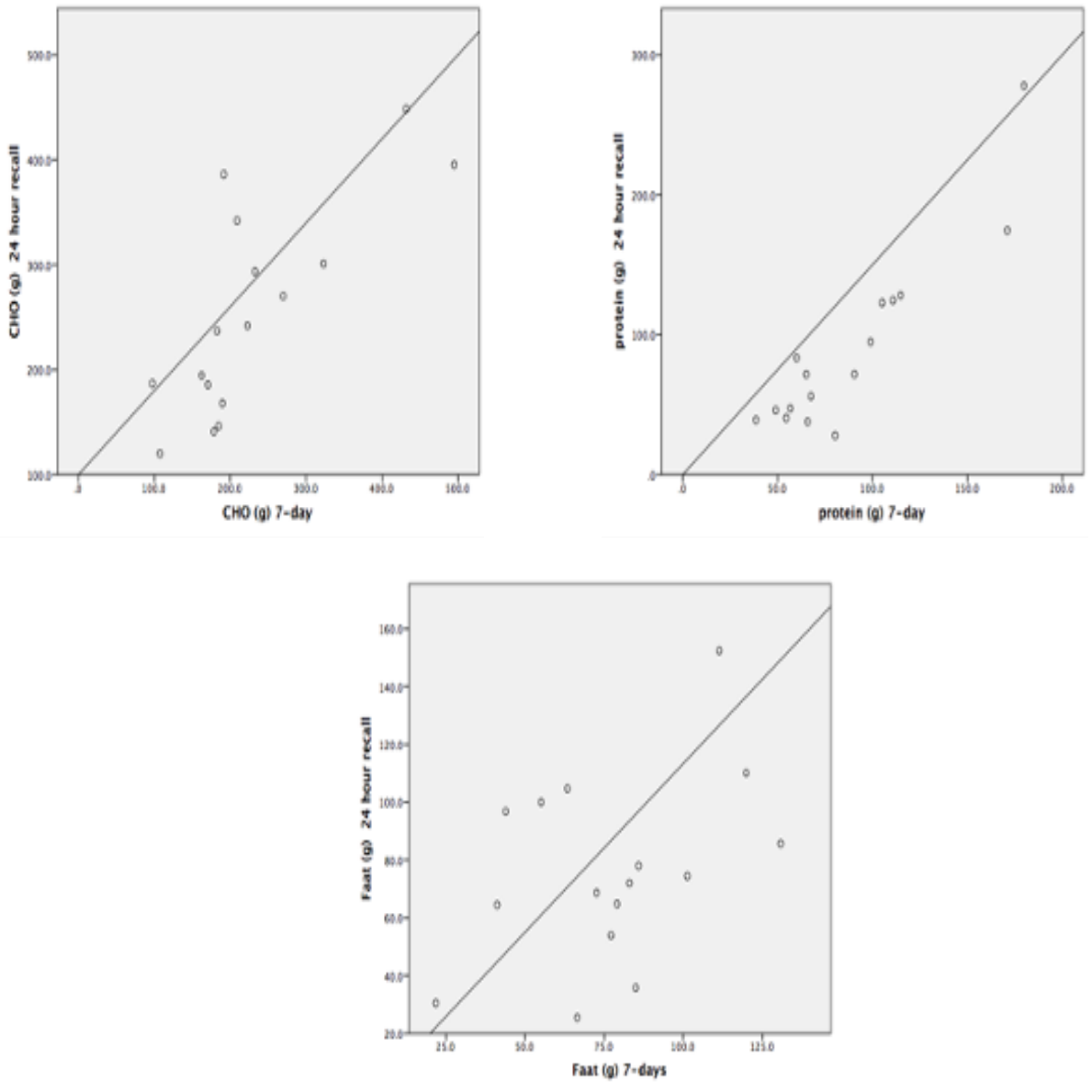

Figure 2-4. Mean & standard deviation of macronutrient intake between both 7-day dietary record & 24-hour recall.

Table 6. Fiber, Iron & Calcium intake according to both 7-day weighed records and 24-hour food recall.

Intake from dietary assessment	Minimum	Maximum	Mean	Std. Deviation	Spearman`s rho correlation
Fiber (gm.) 7-day weighed a record	8.3	43.5	20.1	9.1	Coefficient Correlation: 0.745
Fiber (gm.) 24-hour recall	7.2	43.3	21.9	9.5	Sig. (2-tailed): 0.001
Iron (mg.)7-day weighed a record	3.3	18.5	11.3	3.8	Coefficient Correlation: 0.518
Iron (mg) 24-hour recall	4.5	18.6	12.3	4.3	Sig. (2-tailed): 0.040
Calcium (mg.) 7-day weighed a record	207.0	1925.0	964.2	446.7	Coefficient Correlation: 0.453
Calcium (mg) 24-hour recall	471.0	1409.0	833.8	276.4	Sig. (2-tailed): 0.078

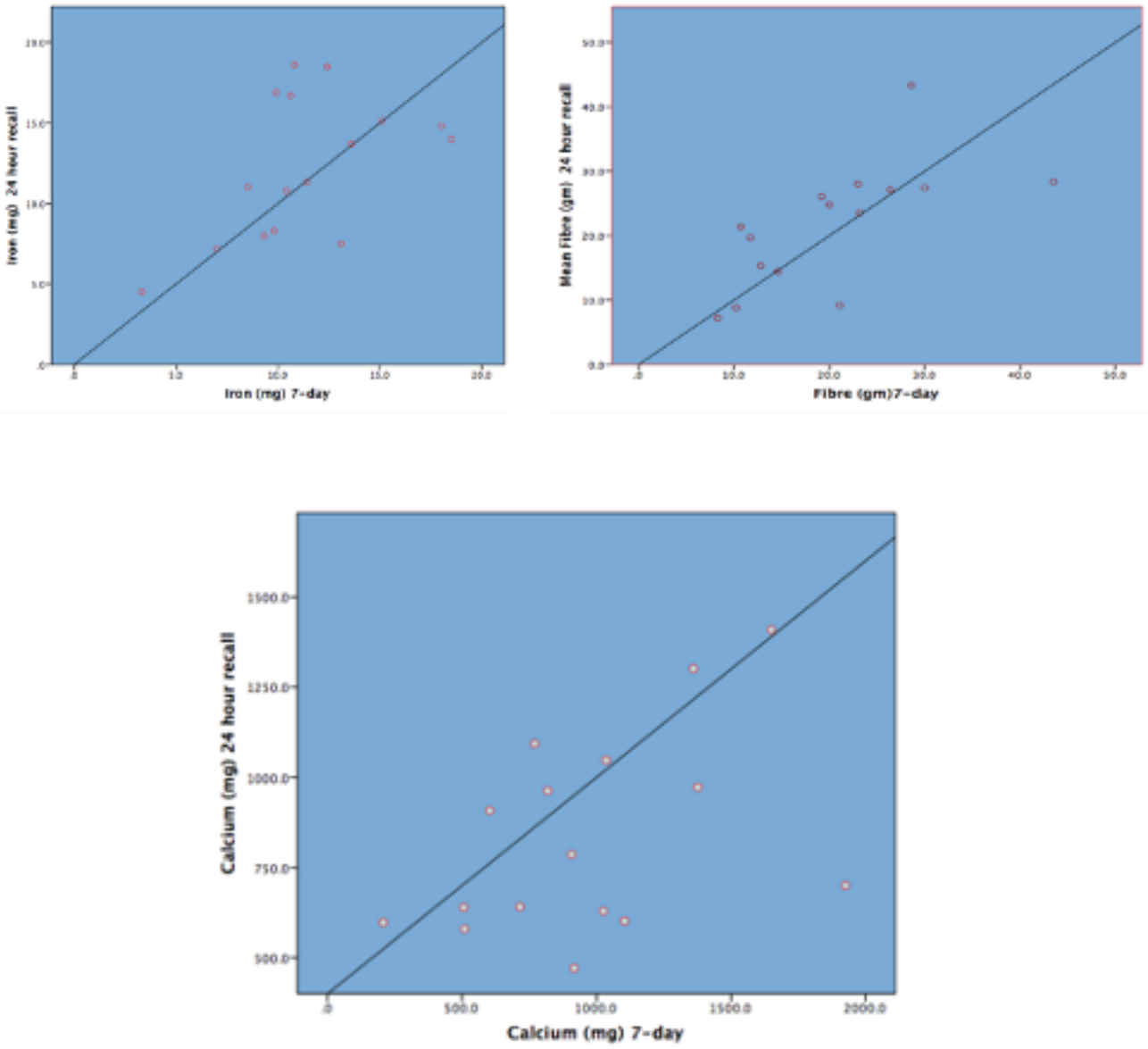

Figure 5-7. Intake of Fiber, Iron, and Calcium according to both methods used.

Table 7. Comparison between energy, protein, and iron, calcium intake from both methods with Reference Nutrient Intake (RNI) for females.

Nutrient intake from both assessment methods	Mean of female subjects	Reference Nutrient Intake for Females 19-50-year-old (mean)
Energy (Cal) 7-day weighed a record	1860	1940 Cal
Energy (Cal) 24-hour recall	1890	
Protein (g) 7-day weighed a record	73.8	45g
Protein (g) 24-hour recall	64.4	
Iron (mg) 7-day weighed a record	12.0	14.8 mg
Iron (mg) 24-hour recall	13.0	
Calcium (mg) 7-day weighed a record	955.1	700 mg
Calcium (mg) 24-hour recall	821.3	

Table 8. Nutrient intake for Males.

Nutrient intake from both assessment methods	Mean of male subjects	Reference Nutrient Intake for males 19-50-year-old (mean)
Energy (Cal) 7-day	2031	2250 Cal
Energy (Cal) 24-hour recall	2170	
Protein (g) 7-day	106.2	55.5 g
Protein (g) 24-hour recall	123.5	
Iron (mg) 7-day	10.4	8.7 mg
Iron (mg) 24-hour recall	11.3	
Calcium (mg) 7-day	976	700 mg
Calcium (mg) 24-hour recall	849.8	

Table 9. A comparison between nutrient intakes and RNI recommendations.

Nutrient	Duplicate result	RNI recommendation (male 19-50) year-old
Energy (kcal)	959	2250
Total protein (gm.)	29.5	103
Total fat (gm.)	26.9	106.9

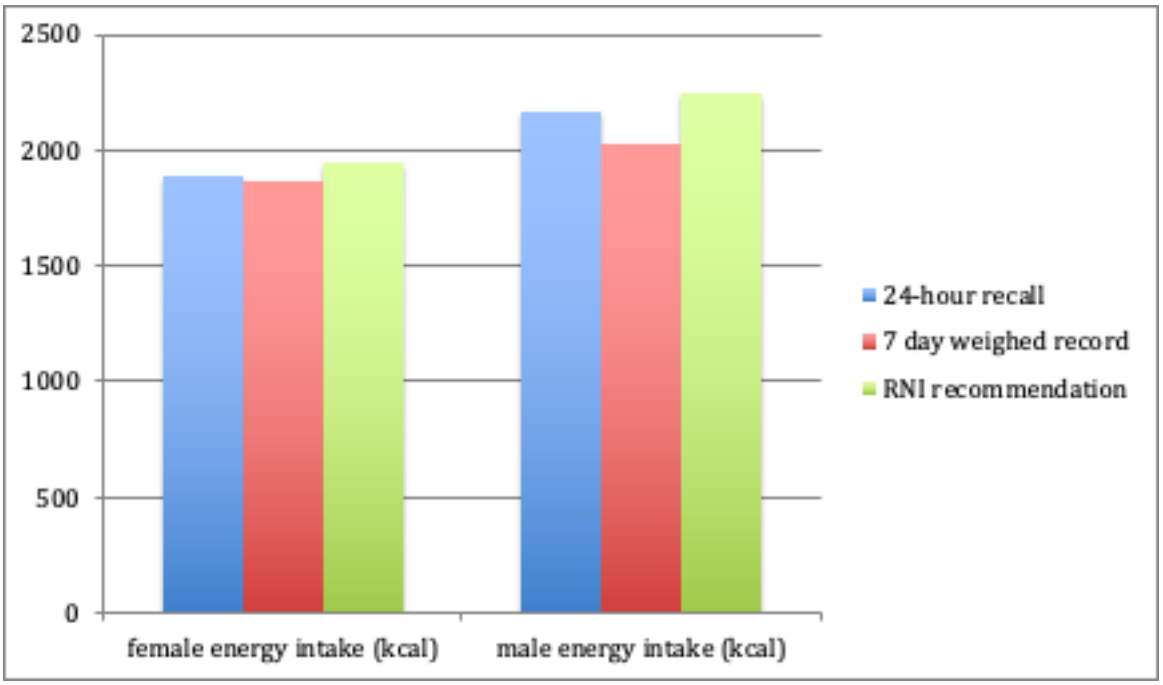

Chart 1 . Compares energy intake from (24-H-R) & (7-D-WR) to RNI recommendations in both sexes

DISCUSSION

The number of female participants exceeded male subjects, mean age was 29 years for both sexes, while mean weight and height were much higher for males, however, mean BMI difference was only 0.1 (22.1 kg/m2 for females & 22.8 kg/m^2. for males).

When analyzing energy intake from using both 7-day weighed record and 24-hour dietary recall, we see that mean intake for the former is 1934 cal. That is lower than later which is 2013 cal. However, there is no statistically significant correlation between these two results. A study that has been done in Korea showed that 24-hour recall underestimated energy daily energy intake and this underestimation depended on age, sex, education and income level, physical activity, and obesity degree [(9)]. On the other hand, the 7-day weighed record method is regarded as a good standard more reliable than 24-hour recall in dietary intake assessment, however, it is expensive and time consuming for both subject and researcher [(10)]. A study in the United kingdom was done for comparing the validity of three different dietary assessment methods showed a strong correlation between dietary intake of nitrogen (N) from weighed records and 24-hour N urinary excretion (0.78-0.87) and the lower correlation between urinary N and N from 24-hour recall (0.10-0.27) [(11)].

Considering macronutrients, there is a significant correlation between both dietary assessment methods for the amount of protein and carbohydrate (CHO) with P. <0.05, however, the correlation is not significant for lipid intake P. =0.144. A study in a rural area in India showed that a modified 24-hour recall method in which eight life-size food portion pictures of famous Indian food were created to help subjects` memory is effective in the assessment of energy, macronutrients, and micronutrients and results were strongly correlated to weighed food records [(12)]. However, repeated 24-hour recalls are needed for a more effective and accurate assessment of nutritional status as 24-hour is not enough to represent a dietary habit of individuals and several food types might be missed [(6, 13)]. The National Food Consumption Survey in South Africa showed that the 24-hour recall method is better to be used at the group level but not at the individual level in regards to assessing energy and macronutrients [(14)].

Mean fiber intake from the 7-day weighed record (20.1 gm.) is lower than mean fiber consumption from 24-hour recall (21.9 gm.), however, there is a significant correlation between the two results r=0.745(16), P=0.001. This is true for iron as well; the higher mean intake iron form 24-hour recall (24-H-RQ) is (22.3 mg.) against only (11.3 mg.) for 7-day weighed record (7-D-WR). This is also significantly correlated according to the Spearman correlation method (P. =0.04). One of the advantages of 24-hour recall is it does not need literacy and only verbal responses are needed. However, it is memory dependent and this is a particular problem in elderly people [(15, 16)]. The reverse is true for mean calcium intake, men's intake is more in (7-D-WR) and there is no significant correlation between the two methods (P. =0.078). A study concluded that daily calcium intake was overestimated when the Food Frequency questionnaire was used in comparison to 24-hour recall [(17)].

Energy intake for both male and female subjects was lower than the recommended daily energy intake form Reference Nutrient Intake (RNI). Mean energy intake of female subjects according to (7-D-WR) & (24-H-R) was 1860 & 1890 kcal. Respectively while RNI energy recommendations for females are 2170 and 2103 kcal for 19-44-year-old female.

RNI energy recommendation is between 2772 and 2629 kcal, for 19-44-year-old males and it was only 2031 and 2170 kcal, according to (7-D-WR) & (24-H-R) respectively. Energy intake underreporting is of a particular issue with all dietary assessment methods, a review of studies that have been done by Trabulsi & Schoeller in which energy intake through several dietary assessment methods were compared to energy expenditure measured using doubly labeled water (DLW) method. This review showed that all methods had some degree of underreporting and this mostly depended on some physical and psychological factors of subjects. It showed that underreporting was increased with rising BMI when using the 24-hour recall method [(17, 18)].

Lastly, when comparing duplicate diet results with RNI recommendation, the intake is lower than recommended. This might look like underreporting from the subject, however as far as I am concerned, it has nothing to underreporting and it reflects the effect of changing environment, eating habits, and related stress that leads to a loss of around three kilos in two weeks.

In conclusion, to sum up, after examining both 7-day weighed food record and 24-hour recall food intake

assessment methods and comparing our examination with other references, we agree on the reality that no method can be regarded as the most appropriate, however, 7- weighed records are still at the top in regards of accuracy. In the future, more studies are needed to make different methods more accurate, practical, and useful.

The paper has no financial or commercial interest.

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