Original Article

Assessment of a rapid method for assessing adequacy of calcium intake

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The purpose of this study was to assess the agreement between the 24 h diet recall and a short 17-item 24 h food intake recall in assessing calcium intake. The calcium intakes of 21 women over the age of 50 were assessed by both methods on four occasions. The mean calcium intakes were similar using both methods, being 1034 ± 398 mg/day by 24 h diet recall and 822 ± 412 mg/day (SD) by 17-item 24 h food intake recall. The 17-item 24 h food intake recall tended to underestimate calcium intake compared with the 24 h diet recall, with the limits of agreement being between –1197 and –727 below and 370 and 682 mg/day above 24 h diet recall values over the four assessments. The 17-item 24 h food intake recall identified 8% more women with inadequate calcium intakes than the 24 h diet recall method did. Although there is poor agreement in calcium intake between the 24 h diet recall method and the 17-item 24 h food intake recall, the latter provides a quick and simple means for assessing extremes of calcium intake and whether day to day calcium intake is adequate.

Key words: calcium, diet recall, food intake, New Zealand.

Introduction

The 24 h diet recall is used widely in large surveys of food consumption, including national surveys that are designed to assess the food and nutrient intakes of populations. Although it lacks the sensitivity to determine the habitual food and nutrient intakes of individuals, the 24 h diet recall may be used to identify the day to day adequacy of nutrient intakes for individuals or small groups of people.

We have recently used the 24 h diet recall as a relatively rapid method for screening the baseline calcium intakes of potential volunteers in studies that investigate the impact of high-calcium milk on human health.[1] However, in our hands, each 24 h recall (including the subsequent nutrient analysis) takes approximately 2 h per person. Therefore, we have developed a short 17-item questionnaire for the 24 h recall of foods that are mostly high in calcium and provide most of the calcium in the New Zealand diet. This takes approximately 15 min to complete. The purpose of the present study was to assess the agreement between the 24 h diet recall and the 17-item 24 h food intake recall for calcium intake.

Materials and methods

Twenty-one healthy women aged 66 ± 7.6 years (SD; range 53–78 years), gave written, informed consent to the procedures that were approved by the Massey University Human Ethics Committee. They attended the Human Studies Laboratory on four separate days, each at least one week apart. Height and weight were measured on one of the visits. Standing height was measured to the nearest 0.1 cm using a stadiometer that was manufactured by technical staff at the Engineering Services Laboratory in the Institute of Fundamental Sciences at this university. Body weight was measured to the nearest 0.2 kg using a beam balance (Detecto, Cardinal Scale Manufacturing, MO, USA).

Two researchers assessed independently the calcium intake of the women. The first researcher used the 24 h recall method, involving a structured interview in which participants were asked to recall foods, portion sizes, cooking methods and the use of nutrient supplements during the preceding 24 h. The second researcher used a 17-item 24 h food intake recall, which is provided in the Appendix to this paper. The recalls were made in random order, without any conferral between the researchers.

The nutrient intakes from the 24 h diet recall were derived using the New Zealand Food Composition Table, which we accessed using nutrient analysis software (FOODworks v2, Xyris Software, Highgate Hill, QLD, Australia). Recipes were used for home-made foods. Where foods were recalled that were not in the database, they were replaced by a similar product at the researcher's discretion. People who

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underreported food intake were identified by comparing their reported energy intake with their basal metabolic rate, calculated by Schofield's equation[2] using measurements of height, weight and age. Underreporters were identified as individuals for whom the ratio of 24 h reported energy intake to estimated basal metabolic rate (BMR) was <1.27, which is the survival value of 1.27 for inactive individuals.[3] The calcium intake from the 17-item 24 h food intake recall was derived using the New Zealand Food Composition Table.

Data are presented as Mean ± 1 standard deviation. Statistical analyses were done using Minitab Statistical Software, v13.1 (Minitab, State College, PA, USA). A sample size of 21 was considered adequate to detect a difference of more than 300 mg Ca with 80% power. Variance in the calcium intake data was determined between each of the two methods on each of the four occasions using the *F*-test and Levene's Test. Two sample *t*-tests were carried out to compare the calcium intake estimated by the two methods. Agreement between the 24 h diet recall and 17-item 24 h food intake recall for calcium intake was assessed by calculating the limits of agreement, using the mean difference and standard deviation of the differences between the two recalls.[4]

The calcium intake data derived from both recalls were grouped separately in quartiles, as described previously by Taylor and Goulding for the purpose of validating a short food frequency questionnaire in young children.[5] The proportion of women that were classified in the same and adjacent quartile groups was calculated, together with the proportion of women deemed to have adequate calcium intakes by both methods.

Results

The average height and weight for the group were 1.63 ± 0.06 m (range 1.52–1.80 m) and 70.8 ± 15.3 kg (range 53.4–119 kg), respectively. Body mass index (weight/height^2) was 26.7 ± 5.6 (range 18.6–43.5).

Underreporting

The mean energy intake for the four 24 h diet recalls was 1.30 ± 0.33 times the estimated BMR. Seven of the 21 women had reported energy intakes that were less than 1.27 times their BMR on each of the four assessments.

Calcium intake

The mean calcium intakes for the four 24 h recalls were 945 ± 514, 1038 ± 421, 1040 ± 456 and 1111 ± 489 mg. The corresponding calcium intakes derived from the 17-item 24 h food intake recall were 695 ± 457, 905 ± 522, 843 ± 430 and 840 ± 448 mg. The mean calcium intakes for four assessments were 1034 ± 398 mg/day by 24 h diet recall and 822 ± 412 mg/day by the 17-item 24 h food intake recall. Variance in the calcium intake data was the same between each method of assessing calcium intake on each of the four occasions (*F*-test and Levene's Test). There was no difference in the estimate of 24 h calcium intake between the two methods that we used (two-sample *t*-test) on any occasion.

The mean differences in calcium intake for the four assessments were 138 ± 410, 166 ± 281, 221 ± 296 and 326 ± 435 mg. Lack of agreement between the two methods for deriving calcium intake is shown in Figure 1. The limits of agreement between the measurements for the four assessments were: –957 to 882 mg, –727 to 396 mg, –813 to 370 mg and –197 to 544 mg.

Approximately three-quarters of the women had calcium intakes that were below the US adequate intake (AI) of 1200 mg. For the 24 h diet recall, the numbers of women with calcium intakes <1200 mg were 15/21, 16/21, 14/21 and 12/21. The corresponding numbers for the 17-item 24 h food intake recall were 17/21, 17/21, 19/21 and 13/21. The calcium intakes of between 18 and 20 of the 21 women were classified in the same or adjacent quartile group for both of the two food intake recalls on any one occasion. Overall, for all four assessments, 93% of calcium intakes were classified in the same or adjacent quartile group (Table 1). Only one of

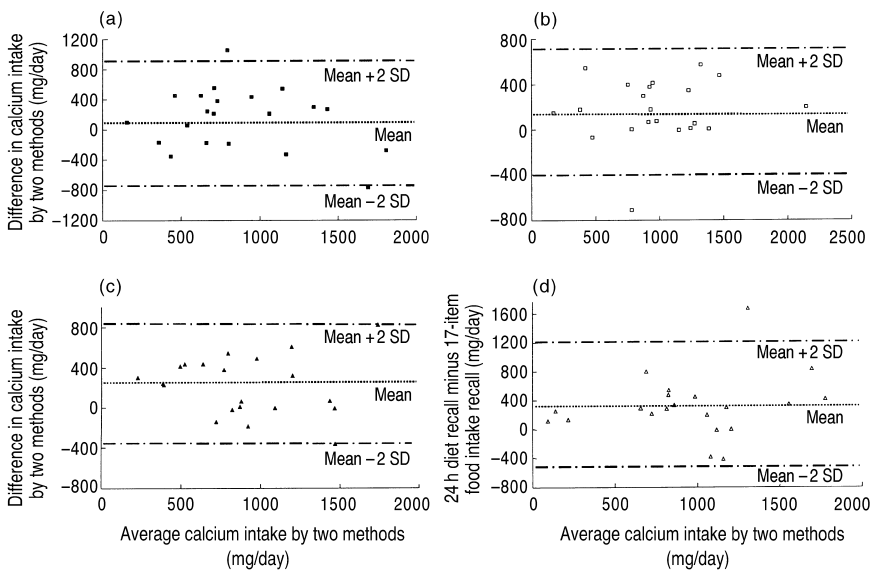

Figure 1. Lack of agreement between the 24 h diet recall and the 17-item 24 h food intake recall for calcium intake. (a–d) show each assessment of calcium intake in the order in which they were performed.

Table 1. Quartile analysis for calcium intake by 24 h diet recall and the 17-item 24 h food intake recall

	24 h diet recall				
17-item 24 h food intake	1	2	3	4	Total
1	13	5	1	1	20
2	6	11	7	0	24
3	1	5	10	4	20
4	0	3	2	15	20
Total	20	24	20	20	84

the 84 calcium intakes was completely misclassified, being in the highest quartile for the 24 h food recall but in the lowest quartile for the 17-item 24 h food intake recall.

Discussion

Any self-reported dietary intake relies on many factors, including the memory of the participants, their ability to estimate portion size and the ability of the researchers to derive an accurate estimate of the nutrient composition of the foods that have been consumed. All of these factors may lead to errors such that, at best, these methods provide estimates rather than measures of nutrient intake. One way to assess the validity of the data is to compare the reported energy intakes with measured or estimated basal metabolic rate. In doing this, we found that the mean reported energy intake was close to the minimal level that would be commensurate with survival for sedentary people. These data suggest either that some women were underreporting their food intake, that there were errors in nutrient analysis, that some individuals were consuming a very low calorie diet or a combination of these factors.

Although there was no difference in the mean calcium intakes derived by either the 24 h diet recall or 17-item 24 h food intake recall, the limits of agreement between the methods were wide. This suggests that the 17-item 24 h food intake recall cannot replace the more detailed 24 h recall if calcium intake is not to be underestimated.

However, the 17-item 24 h food intake recall seems to be as good as the 24 h diet recall for the purposes of screening for adequate calcium intake. If the 17-item 24 h food intake recall were used to identify individuals with inadequate calcium intakes, then 8% more women would be included than if the 24 h diet recall were used. We re-examined the food intake data for the one individual whose calcium intake was classified as being in the highest quartile group by the 24 h diet recall method but the lowest quartile by the 17-item 24 h food intake recall. This was explained by a range of low calcium foods that were detected by the 24 h food recall, and which contributed to the total calcium intake, but were not included in the 17-item 24 h food intake recall. Differences in calcium intake also came about when the reported food was not in the database, and each researcher made a different choice for a similar food.

In conclusion, the 17-item 24 h food intake recall provides a simple and fast tool for screening individuals with adequate (or inadequate) calcium intakes. However, it does not provide an alternative to the 24 h diet recall if more accurate estimates of calcium intake are required.

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Appendix

17-Item 24 h Food Intake Recall

Subject ID…….. Date today……..

Day and date of recall……..

Please state the number of serves, and the type/brand of the product.
This recall is for a **24-h** period.

e.g., Milk – 1 serve – skim (brand name)
or Milk – half serve – soy (brand name)

Food	**One serve**	**No. serves**	**Type**
Milk*	1 glass (200 mL)		
Yoghurt	1 pottle (150 g)		
Dairy dessert	1 pottle (150 g)		
Cream	2 tablespoons (30 mL)		
Ice cream	1 slice (150 g)		
Cheese	40 g (3 cm^3 block)		
Bread	1 medium-sized slice		
Muesli	1 medium bowl		
Banana	1 medium		
Baked beans	1 cup		
Broccoli	1 cup		
Carrots	1 medium		
Shell fish	1 cup		
Sardines	$^1/_2$ tin		
Salmon (bony)	1 cup		
Tofu	125 g (3 cubes)		
Nuts/seeds	$^1/_2$ cup		

*Milk in tea/coffee is usually equal to about 1/5 glass.