

Dietary Calcium Intake Assessment by Short Food Frequency Questionnaire in Thais Adults Living in Chiang Mai, Thailand

Chuleegone Sornsuvit*, Pennapa Saowapichart, Suchavadee Meechai and Apiradee Longlaloeng

Department of Pharmaceutical Care, Faculty of Pharmacy, Chiang Mai University, Suthep Road, Maung, Chiangmai 50200, Thailand

Abstract: The aims of this study were to develop and validate the short food frequency questionnaire (sFFQ) to assess calcium intake from food in Thais person for use in clinical practice or community pharmacy.

Data collection was performed during November 2009 to January 2010. The sFFQ consisted of 33 item of food. The frequency of food intake in sFFQ food list was interviewed by investigator. Seven day after subject were interviewed by sFFQ, subjects were asked to fill out the Three Day Dietary Record (3DR) for 3 day. Daily calcium intake assessed by both methods was calculated by using INMUCAL software, which was developed by the Institute of Nutrition, Mahidol University.

The 131 subjects who completed sFFQ and 3DR had mean age of 24.4 years, 71.3% were female. The mean daily calcium intake assessed by sFFQ and 3DR were 692.0 ± 524.9 mg and 477.4 ± 261.9 mg, respectively. The mean daily calcium intakes assessed by sFFQ were significantly higher than 3DR ($p < 0.05$). The Spearman's correlation coefficient between calcium intakes assessed by the two methods was 0.18 ($p < 0.05$).

In conclusion, the newly developed sFFQ was a suitable tool for the determination of calcium intakes in Thais adults. The next step in assessing the validity of this sFFQ will be its use in clinical setting such as community pharmacy or out-patient clinic.

Keywords: Calcium, short food frequency questionnaire, intake, dietary record.

INTRODUCTION

Calcium is a primary bone-forming mineral required in adequate amounts throughout the entire life to achieve peak bone mass, maintain bone mass, minimize bone loss and reduce the incidence of osteoporosis [1]. The dietary references intake for Thais 2003 established by Nutrition Division, Department of Health, Ministry of Public Health, recommended intake of 800-1000 milligrams of calcium to meet the adequate intakes in adolescent and adult [2]. These intake levels appear sufficient to achieve peak bone mass during growth and to minimize bone mineral loss in adulthood. However, majority of Thais intake calcium lower amount than the recommended amount [3-5].

The duplicate portion sampling method is considered to be the most reliable way to accurately determine calcium consumption [6]. Self-administered diet assessment methods such as twenty-four hour recall and food diary also are the method to determine calcium consumption [7]. Those methods are time-consuming and require many hours or days to

complete, which are not feasible in clinical or community practice. The short or easy tool for assessing dietary calcium intake would be useful for health care professional in clinical practice including pharmacist in community pharmacy [8-10]. These because of health care professional often assess calcium intake from food and has short of time to dietary history graining before recommended food rich in calcium or calcium product for patient who has risk of low calcium intake from food. The sFFQ would be short list of food item, used short of time to data processing, cheap and finally convenience. Thus, the aims of this study were to develop and validate the short FFQ in order to assess calcium intake from food in Thais adults for later use in clinical practice or community pharmacy.

MATERIALS AND METHODS

Subjects

The 131 of 890 students and staffs from the faculty of pharmacy, Chiang Mai University were quota random into the study. The study was carried out in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethical Review Committee, Faculty of Pharmacy, Chiang Mai University.

*Address corresponding to this author at the Department of Pharmaceutical Care, Faculty of Pharmacy, Chiang Mai University, Suthep Road, Maung, Chiangmai 50200, Thailand; Tel: 66-5394-4342; Fax: 66-5322-2741; E-mails: chuleekorn@pharmacy.cmu.ac.th; chujang@hotmail.com

Food Item in Short Food Frequency Questionnaire (sFFQ)

List of food item were selected from food rich in calcium and commonly ingested by Thais people [11-13]. List of food compose of 33 item of food in 5 of food groups i.e. milk and milk product, rice and flour, nut and bean, meat, vegetable and fruit group. The sFFQ did not include calcium-fortified food and calcium supplements.

Data Collection from sFFQ and 3DR

Data collection was performed during November 2009 to January 2010. The frequency of food intake in sFFQ food list was interviewed by investigator. Each subject indicated her frequency and usual portion size of consumption of each item and investigator filled out the sFFQ. Seven day after subject interviewed by sFFQ, subjects were asked to fill out the 3DR for 3 day.

Daily Calcium Intake

Daily calcium intake was assessed from sFFQ and calculated by 1) average amount of each food item intake to be amount per day, 2) analyzed amount of calcium in each food item intake by using INMUCAL software, which was developed by the Institute of Nutrition, Mahidol University, 3) sum of calcium amount from each food item.

Daily calcium intake assessed from 3DR was calculated 1) by using INMUCAL software, which was developed by the Institute of Nutrition, Mahidol University, 2) calcium amount was divided by 3 to determine daily calcium intake.

Statistical Analysis

The Kolmogorov-Smirnov test was done to test for normality of distribution of calcium intakes. Spearman's correlation analysis was done to test for correlation between calcium intakes estimated by sFFQ and 3DR. In addition, correlation between calcium intake assessed by sFFQ separated into food groups and calcium amount assessed by 3DR was also analyzed by Spearman's correlation analysis method. The Wilcoxon signed rank test was used to test the difference between sFFQ and 3DR values. A p value less than 0.05 was considered statistically significant. All statistical analysis was done using the SPSS package (version 17, SPSS Inc., Chicago, IL, USA).

RESULTS

The 131 subjects who completed sFFQ and 3DR had mean age of 24.4 ± 9.0 years, 71.8% were female. (Table 1) The mean daily calcium intake assessed by sFFQ and 3DR were 692.0 ± 524.9 mg and 477.4 ± 261.9 mg, respectively. The mean daily calcium intakes assessed by sFFQ were significantly higher than 3DR ($p < 0.05$) (Table 2). The Spearman's correlation coefficient between calcium intakes assessed by the two methods was 0.18 ($p < 0.05$).

Table 1: Subject Characteristics (n = 131)

Characteristics	
Sex (%)	
Males	28.2
Females	71.8
Ages (y)	24.4 ± 9.0
Age range(y)	15-56
Daily dietary Intake from 3DR	
Energy(kcal)	1494.7 ± 817.6
Carbohydrate(g)	195.5 ± 121.4
Fat(g)	48.6 ± 26.5
Protein(g)	72.3 ± 51.2

Table 2: Daily Calcium Intake Assessed by Short sFFQ and 3DR

	Calcium Intake (mg)	
	3DR	sFFQ
Mean \pm SD	477.4 ± 261.9	$692.0 \pm 524.9^*$
Mode (IQR)	414.2 (262.9)	522.4 (535.7)
Min-Max	78.3 - 1558.7	38.3 - 2679.1

*significantly different at $p \leq 0.05$

Lists of food items in sFFQ as shown in Table 3, consisted of 33 food items. The major source of daily calcium as determined from sFFQ method were milk (91.3 mg/d), small fish eaten whole (89.6 mg/d), drinkable yogurt (81.4 mg/d), vegetable such as kale (33.9 mg/d) and chinese cabbage(44.9 mg/d), sardine in tomato sauce(24.5 mg/d). Among the sFFQ 5 food groups. Meats group was the largest source of calcium intake (151.9 mg/d) compared to others groups (≤ 132.6 mg/d). The correlation coefficient for the calcium intake from vegetable group was 0.19 ($p \leq 0.05$) (Table 4).

DISCUSSIONS

Recommended intake [2] of calcium in Thais adults is 800-1000 mg/d. The mean calcium intake assessed

Table 3: The sFFQ Food Items

Item	Food name	Item	Food name
1	Milk, unflavored	18	Soy bean milk, vegetarian
2	Milk, flavored	19	Soft tofu with egg
3	Drinkable yogurt	20	Peanut
4	Yogurt	21	Sunflower seed
5	Rice and glutinous rice	22	Sesame
6	Bread	23	Kale
7	Rice noodle	24	Morning glory
8	Cooked pork	25	Chinese cabbage
9	Cooked chicken	26	Cantonese lettuce
10	Small fish eaten whole	27	Gourd leaf
11	Egg	28	Mustard greens
12	Shrimp and shrimp paste	29	Orange
13	Sardine fish in tomato sauce	30	Mango
14	Fried tilapia fish	31	Pineapple
15	Green bean	32	Watermelon
16	Tofu milk	33	Papaya
17	Soy bean milk, with milk		

in this study was 477.8 mg/d (3DR) and 692.0 mg/d (sFFQ) which were lower than the recommended value. The results were consistent with the study of Pongchaiyakul *et al.* [3] and Cailurkit *et al.* [5]. Pongchaiyakul *et al.* studied in rural area of Thailand (Khon Kaen province) reported mean calcium intake was 378.6 mg/d in male and 265.6 mg/d in female. Cailurkit *et al.*, studied in urban area (Bangkok metropolitan) reported mean calcium intake was 309.5 mg/d (female). However, our results were higher for calcium intake than those results. These might be due to the younger ages of our subject. The new generation

of Thais intake more milk product than old generation. The other reasons might be study area, Chiang Mai province is a big city of northern part of Thailand, food patterns are different from other rural areas. Among the major source of calcium, our results showed that milk products were in top three of the highest source of calcium intake. These were also different from Pongchaiyakul *et al.* [3] results in which milk product were not the major sources of calcium. Thus, the tool for the determination of food intake pattern for each area and age group should be developed.

Table 4: Correlation Between Calcium Amount Assessed by sFFQ Separated into Food Groups and Calcium Amount Assessed by 3DR

Food groups	Calcium intake (mean, mg)	r*
Meat	151.9	0.15
Vegetables	132.6	0.19**
Milk and milk product	128.6	0.12
Nuts and bean	50.8	0.06
Fruits	36.9	0.13

*r = Spearman rho of Spearman's correlation

** Correlation significant at $p \leq 0.05$ (2 tailed)

Meats group was the largest source of calcium intake. This might be because meats groups consist of small fish eaten whole which is a major source of calcium. Vegetables were also the major sources of calcium in our study, but the amount of absorption is questionable.

The correlation between two calcium intakes (sFFQ and 3DR) assessment methods was significantly correlated, the Spearman correlation coefficient was 0.18 ($p < 0.05$). The correlations were different from previous studies [14-21]. The correlations between FFQ and dietary record have been reported in the range of 0.33-0.67 [14, 16, 17, 20]. The correlations between FFQ and 24 hour recall tend to report higher correlation coefficient (0.42-0.84) than correlation

between FFQ and food record [15, 17-19]. The reference measurement should be as accurate and as precise as possible in order to validate the developing sFFQ. The 3DR might have reflected recent calcium intake which was not reflective of the usual calcium intake. Number of dietary record is also an important factor that affected the correlation [18], while seasonal variation did not much occurs in the intake of calcium [22, 23].

Strengths and Limitations

There are two strengths of this study. First, the sFFQ was developed for a specific rural big city like Chiang Mai, which differed from other rural area. Secondly, the developed sFFQ is simple and convenient; it consists of only 33 items of food to complete. But there were also some limitations in this study. First, the one time 3DR may not accurately estimate calcium intake, multiple 3DR or 7DR might be better. Second, in this study we validated only correlation between reference method and sFFQ, but we did not test for reproducibility of sFFQ. These limitations should be addressed by modifying this sFFQ in future studies.

In conclusion, the newly developed sFFQ was a suitable tool for the determination of calcium intakes by Thais adults living in Chiang Mai province. The next step in assessing the validity of this sFFQ will be to use it in a clinical setting such as community pharmacy or out-patient clinic.

CONFLICT OF INTEREST

All authors declared there is no conflict of interest.

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