ORIGINAL

Daily calcium intake and physical activity status in urban women living on low incomes in Davao, Philippines : a primary study for osteoporosis prevention

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This study investigated daily calcium intake, main calcium sources, and pedometer determined walking steps among urban Filipino women living on low-incomes. Their calcium intake was far below the national average and main calcium sources were small fish and plant foods.

Abstract : Low calcium intake and physical inactivity are modifiable risk factors of osteoporosis ; however, little information is available about the prevalence of these risk factors among urban Filipino women living on low-incomes. The present study, therefore, investigated daily calcium intake, main calcium sources, and physical activity status in this population. The study group comprised healthy women aged in their 30 s who had participated in our previous survey using heel speed of sound (SOS) measurement in Davao, Philippines. The women were stratified into three groups based on SOS score and 20 were randomly selected from each, giving 60 in total. Calcium intake was measured by direct analysis of the food samples collected from 3-days 24 hour-food duplicate method. Physical activity was estimated based on pedometer determined walking steps over 5 days. The median [25%, 75%] calcium intake per day was 289 [225, 434] mg. Traditional foods derived from local small fish and plants were the main calcium sources. The median walking steps per day was 8750 [6920, 10836]. Although three groups did not show significantly different calcium intakes and walking steps, consumption of low-cost small fish and plant foods could be encouraged along with walking in urban Filipino women living on low-incomes. J. Med. Invest. 56 : 130-135, August, 2009

Keywords **:** *urban health, calcium intake, walking, osteoporosis, developing countries*

INTRODUCTION

Low calcium intake and physical inactivity are both considered to be modifiable risk factors for osteoporosis (1). The Sixth National Nutrition Survey of the Philippines in the year 2003 using food-weighing method, found the mean calcium intake per person per day as 440 mg, which was 57% of the recommended calcium intake for Filipinos (2). By contrast, Natera and colleagues tested the calcium content of foods that were easily available and commonly consumed by Filipinos, and estimated the average calcium intake to be 250 mg per day (3). The discrepancy between the results of these studies

Received for publication January 22, 2009 ; accepted April 9, 2009.

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promoted us to measure the daily calcium intake of the participants in our previous survey of heel speed of sound (SOS) measurement using a quantitative ultrasonic bone densitometer (CM-100 ; Furuno Electric Co., Nishinomiya, Japan) to estimate their bone density because the majority of the participants were living on low-incomes (that is, below US$1.35/person/day as absolute poverty threshold in Asia) (4). A dietary transition study of Filipino between 1978 and 2003 indicated that the diet of urban population is predominantly based on energy dense foods and lacking micronutrients (2) ; however, little is known about the diet of urban population living on low-incomes. Especially, our previous survey identified that the prevalence of osteoporosis among the postmenopausal women living on low-incomes in urban Davao was 19.8% and we advocated preventive measures (5).

Counting the number of daily walking steps with a pedometer is useful to estimate the daily physical activity of individuals in a community setting (6). Our current cross-sectional study, thus investigated daily calcium intake, main calcium sources and daily physical activity status (that is, walking measured as pedometer determined steps) among the women in our previous study, with the aim of identifying practical preventive measures for osteoporosis among this population.

MATERIALS AND METHODS

The dietary data collection of current survey started on March 21st and finished on April 2nd in the year 2007, more or less three months after the SOS measurement, on the days when no organized social events were being held within the urban community. We focused on women aged in their 30 s, because this age group showed a significant decline of SOS score of heel measured, compared with 20 s age group in our previous study (5). The 191 women aged in their 30 s who were healthy and non-pregnant/non-lactating at the time of recruitment were stratified into three groups (high, middle, and low) according to their SOS scores. Then, 20 women were randomly selected from each of these groups and invited to participate in the current study.

We employed a food-duplicate method in this study because our preliminary survey conducted in 2006 demonstrated that estimating portion size using the 24-hours dietary-recall method was difficult for the participants. The local tradition of shared plate eating appeared to have caused the methodological difficulties as stated by Harrison previously (7).

The protocol and procedures for food-duplicates were referred to previous studies (8). In the current study, the participants were asked to prepare double portions of all meals, drinks (except tap/well water), and snacks on two non-consecutive week days and one day at weekend. Each duplicated sample was placed into a plastic bag and stored in an opaque plastic box in the refrigerator at home or neighbor's. For tap/well water, the amount consumed was recorded. For each duplicated sample, the participants were asked to record the name of the dish, and ingredients on a form, and also to document any events (such as attending a party or experiencing sickness). Samples taken on a day when such events occurred were to be excluded from the analysis. The duplicated meal was collected daily. At the time of collection, a face to face interview was conducted with each participant, and the food record was compared with the food samples to check the accuracy. The interview provided the in-depth information about the food samples, for example, whether a participant consumed head and/or bone of fish. This information was documented, and the weight of each food sample was measured and recorded on the food record form as additional information. The tendency to eat less food than usual during the periods of duplicate meal collection was taken into account (9). Therefore, the participants were given careful instructions about the protocol and procedures for food duplicates in a guidance session, and were ask to cook and eat ordinary everyday meals. The food samples from the 3 days were mixed together, homogenized, and frozen, and then transferred to Tokyo, Japan for analysis at a laboratory.

In total, five samples of well water and three samples of tap water from the blocks where the participants lived were collected in order to determine the calcium contents. The water samples were frozen and transferred to the laboratory in Tokyo. The laboratory used inductively-coupled plasma atomic-emission spectrometry to analyze the food samples (Vista-PRO, Varian, Inc. CA, USA) and the water samples (Optima 5300DV, Perkin Elmer, Inc. Mass. USA).

We estimated the level of physical activity by measuring the number of walking steps taken daily because our previous survey found that walking

was the common type of exercise among the women of the surveyed area (5, 6). Each participant was provided with a pedometer (SW-200 ; Yamax Co. Tokyo, Japan), a waist belt, and a form on which to record the number of steps daily. The participants were instructed to wear pedometer on the belt around their waist from the moment they got up to the time they went to bed for 5 consecutive days during food duplication and collection period. They were asked to maintain normal daily activity during the days on which the number of steps was measured and told not to reset the instrument to zero but to record the count on the paper form before going to bed (10). The pedometer count and the record form were checked at the time of each duplicated food sample collection.

The study was conducted according to the principles expressed in the Declaration of Helsinki. During the guidance session, the study participants were instructed about the protection of their privacy, the voluntary nature of their participation, and their freedom to withdrawal. Signed consent form was obtained from each participant. This protocol was approved by the Ethical Committee of Biomedical Research, Ochanomizu University, Tokyo, Japan.

The foods consumed were grouped into 26 categories based on the local traditional menu. Local calcium sources were investigated referring to *The Philippine Food Composition Tables 1997* (11). In addition to calcium intake per day and pedometer determined walking steps per day, the results of the anthropometry, age, duration of education by year, family income per person in the year 2005 by US$, and SOS scores in three groups measured during the previous survey were compared using Kruskal-Wallis test. SPSS version 12 was used for statistical analysis. The level of the significance was < 0.05 on two tailed test.

RESULTS

In total, 58 women completed the survey schedule. The median [25%, 75%] calcium intake and pedometer-determined walking steps per day were 289 [225, 434] mg and 8750 [6920, 10836], respectively. Nineteen women (33%) were overweight (Body mass index ≥ 25). The duration of education of 40 women (69%) was 10 years and/or over. Completing 10 years school education means these women were high school graduates in the school system of the Philippines. Forty six women (79%) lived below absolute poverty threshold in Asia (4).

Table 1 compares the distribution of variables in three SOS groups. The three groups did not show statistically significant differences in calcium intake, walking steps per day, and other variables except for SOS, duration of education, and family income per person. The SOS middle group showed the longest duration of education and the highest family income per person.

Two women consumed 750 mg calcium per day, which was the recommended calcium intake for Filipino women aged 30 s (2). The woman who had a calcium intake of 869 mg per day was in SOS high group, and the women who had a calcium intake of

Table 1. Distribution of variables in 3 groups of women aged 30 s ($n = 58$)

Variables	SOS high group ($n = 20$)		SOS middle group ($n = 20$)		SOS low group ($n = 18$)		
	Median	[25%, 75%]	Median	[25%, 75%]	Median	[25%, 75%]	p*
Ca intake/day (mg)	316	[253, 472]	336	[198, 400]	250	[211, 450]	0.378
Pedometer determined walking steps	8750	[7792, 12244]	8794	[6580, 10740]	8586	[6262, 10133]	0.458
SOS (m/s)	1558	[1544, 1568]	1526	[1518, 1535]	1499	[1485, 1507]	< 0.001
Body weight (kg)	52.2	[45.0, 56.2]	54.8	[50.1, 64.8]	52.8	[48.5, 64.3]	0.365
Body height (cm)	149.2	[147.0, 154.7]	152.9	[147.9, 157.3]	152.9	[149.9, 155.8]	0.429
Body Mass Index**	23.3	[20.2, 25.1]	23.9	[22.9, 26.9]	23.1	[19.8, 26.2]	0.403
Age	34	[31, 37]	35	[33, 37]	34	[33, 38]	0.433
Duration of education (year)	10	[8, 12]	10	[10, 14]	10	[6, 10]	0.025
Family income/person in 2005 (US$)	321	[142, 477]	350	[214, 630]	189	[105, 275]	0.013

*p value was determined by Kruskal Wallis Test.
**Weight (kg)/height $(m)^2$

783 mg per day was in SOS middle group. Table 2 shows the pedometer determined walking steps per day, and other variables of the two women and the median [25%, 75%] of 58 women. The durations of education of the two women were shorter than median.

Milk and dairy products were not consumed with the exception of powdered milk mixed with powdered coffee. The food intakes of the two women whose calcium consumption from food was over 750 mg per day were compared with median [25%, 75%] food consumption for all 58 women on Table 3.

Table 2. Pedometer determined walking steps and other characteristics of 2 women who consumed recommended Ca intake (750 mg/day) compared to the median value of 58 women

Variables	Woman with Ca 869/day (mg)	Woman with Ca 783/day (mg)	Median of 58 women	[25%, 75%]
Pedometer determined walking steps	7631	10769	8750	[6920, 10836]
Speed of Sound (SOS) m/s	1562	1527	1526	[1508, 1545]
Body weight (kg)	54.7	65.0	53.2	[48.5, 61.0]
Body height (cm)	152.3	157.9	151.8	[148.2, 155.4]
Body Mass Index	23.6	26.1	23.4	[20.8, 26.0]
Age	30	38	35	[33, 37]
Duration of education (year)	6	8	10	[8, 12]
Family income/person in 2005 (US$)	300	192	277	[149, 480]

Table 3. Daily dietary characteristics of 2 women who consumed recommended Ca intake (750 mg/day) compared to median food intakes/day of 58 women

Food groups	Food or dish/day (g)			*n* (%)*
	Woman with Ca 869/day (mg)	Woman with Ca 783/day (mg)	Median [25%, 75%] of 58 women	
Dairy and the products except powdered milk	0.0	0.0	0.0 [0.0, 0.0]	0 (0)
Powder milk intake frequency	0.3	0.0	0.0 [0.0, 0.7]	16 (27.6)**
Small fish with bone and head eaten	16.0	14.3	0.0 [0.0, 0.3]	17 (29.3)
Fried fish & dried fish with bone and/or head eaten occasionally	16.0	50.0	15.3 [7.9, 27.8]	49 (84.5)
Paksiw, escabethce, fried large fish, etc	0.0	0.0	22.0 [8.7, 47.0]	47 (81.0)
Meat adovo, chop, etc	0.0	6.0	0.0 [0.0, 19.7]	27 (46.6)
Processed meat (chorizo, sausage, roasted, etc)	0.0	0.0	0.0 [0.0, 15.3]	25 (43.1)
Canned sardine	0.0	0.0	0.0 [0.0, 0.0]	9 (15.5)
Boiled/fried egg	16.7	0.0	0.0 [0.0, 16.8]	27 (46.6)
Lao-uy (vegetable soup with small fish)	62.3	125.0	0.0 [0.0, 4.6]	14 (24.1)
Fish soup	64.0	9.3	28.8 [0.0, 55.8]	35 (60.3)
Fruit soup	143.0	0.0	0.0 [0.0, 0.0]	9 (15.5)
Meat soup	0.0	0.0	0.0 [0.0, 64.0]	17 (29.3)
Vegetable dishes	163.7	143.7	50.8 [0.0, 81.7]	41 (70.7)
Banana/banana cue	44.7	145.0	0.0 [0.0, 38.9]	24 (41.4)
Guso (sea grasses)	0.0	58.0	0.0 [0.0, 0.0]	8 (13.8)
Mong bean	0.0	53.3	0.0 [0.0, 0.3]	19 (32.8)
Sweet potato	98.0	0.0	0.0 [0.0, 0.0]	2 (3.4)
Fruits except banana & fruit soup	0.0	214.0	0.0 [0.0, 28.6]	19 (32.8)
Rice	727.7	297.3	510.1 [435.0, 640.8]	58 (100)
Corn grits	0.0	196.0	0.0 [0.0, 0.0]	4 (6.9)
Bread	54.7	61.7	29.1 [11.9, 56.4]	47 (81.0)
Behon, green bean noodles, etc	53.7	82.7	28.3 [0.0, 70.1]	35 (60.3)
Instant noodles, spaghetti, etc	21.7	0.0	0.0 [0.0, 0.0]	13 (22.4)
Cereal snacks	0.0	55.5	3.7 [0.0, 32.8]	30 (51.7)
Carbonated soft drink intake (cup)	1.3	0.3	0.7 [0.3, 1.0]	47 (81.0)**

* n (%) shows the number of women who consumed the foods/dishes during the survey days
** not shown by (g)

In total, twenty-two women used tap water while the remainder used well water. The mean calcium contents of tap-water and well-water samples were 17.0 mg/L and 8.6 mg/L, respectively. One woman took a calcium supplement, but it was not mixed with a food sample data. Nine women took over 12,000 steps per day, which was the recommended number of pedometer-determined steps for health maintenance (12).

DISCUSSION

The women in our survey had a calcium intake far below the national average and the Recommended Energy and Nutrition Intake decided by the Government of the Philippines. The consumption of dairy products was extremely limited because most of these foods were imported and expensive to purchase in the Philippines (13). However, the local small fish (such as sardine and small scad) eaten with heads and/or bones intact and plant foods that formed part of the Filipino traditional diet were found to be good sources of calcium.

Two women, whose calcium intakes were more than 750 mg per day, consumed more small fish (including the bone and/or head), vegetable soup with small fish, vegetable dishes (including green leafy vegetables), and 'banana cue' (deep-fried saba-banana rolled in brown sugar) than the majority (75%) of the women. One of these women, who had a calcium intake of 869 mg per day, consumed more sweet potato, small fish soup, and eggs than the majority. The other woman had a calcium intake of 783 mg per day and consumed more fried/dried small fish eaten including the bone and/or head, sea grasses, and mong beans than the majority. These traditional low cost foods appeared to have provided two women with sufficient calcium, although the foods did vary in their calcium contents according to *The Philippine Food Composition Tables 1997* (11). These two women did not eat large fish, canned sardine, or processed meat. Both of them consumed more bread than the median of 58 women, and woman whose calcium intake was 869 mg per day consumed more rice than the median, although these foods could not account for their high calcium intakes. The effects of water sources on calcium intake could be negligible.

The median number of steps taken per day was similar to that reported in a study that used a SW-200 pedometer in USA (14). Walking should be promoted among the inactive urban women who took less than 12,000 steps daily.

The different SOS groups did not show significantly different calcium intakes and walking steps. Our small sample size might have caused the weak statistical power. We could not include several nutrients that were reported to affect bone density (15) and total energy intakes in our analysis, which we consider other limitations of this study. However, to our knowledge, this is the first study to measure daily calcium intake and physical activity status among under-studied urban Filipino women living on low incomes. We found that food-duplicate method was an excellent method to measure a single nutrient intake when validity of portion size estimation in 24-hours dietary recall was questionable.

In conclusion, traditional low-cost small fish and plant foods were found to provide calcium to urban Filipino women living on low-incomes. Calcium balance test using these local foods will be needed to support our results in order to confirm the consistency with the previous studies (16, 17). We believe that our findings will help improve the nutritional and physical activity status of these women.

ACKNOWLEDGEMENTS

The authors thank all the women who participated in this study. The health workers of Japan Philippine Volunteer Association are gratefully acknowledged for there excellent work in data collection.

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