Mal J Nutr 16(1): 91 - 100, 2010

Calcium Intake among Myanmar Residing in Bago, Kayin, and Yangon Areas

Phyu Phyu Aung[1], Mya Ohnmar[1], Moh Moh Hlaing[2], Moe Thida Kyaw[1], Aye Aye Than[1], Theingi Thwin[1] & Tin Khine Myint[2]

[1] *Nutrition Research Division, Department of Medical Research (Lower Myanmar)*
[2] *Physiology Research Division, Department of Medical Research (Lower Myanmar)*

ABSTRACT

A cross-sectional survey combined with 24-hour dietary recall and food diary was undertaken to assess the calcium intake of the Myanmar population. The study was conducted from November 2003 to October 2005. A total of 886 subjects of both sexes aged above 2 years from three States and Divisions (Bago, Kayin, and Yangon) of Myanmar were included in the study. The major measures were mean daily calcium intake (mg / day) and major sources of calcium in the diet. Overall mean calcium intake was 197±13mg / day (2-9 years), 421±2mg / day (10-19 years), 399±21 mg / day (20-49 years), and 383±25mg / day (≥50 years) for males, while the corresponding values for females were 207±17 mg / day, 366±19 mg / day, 387±16 mg / day, and 327 +19 mg / day. Calcium intake was less than 80% of the recommended dietary allowances (RDA) for Myanmar for ages 2-9 years and 10-29 years in all the study areas, and for the 50 years and above age group in Yangon. Fish paste was found to be the major source of calcium. Milk and milk products contributed very little to total calcium intake, contributing 2.1% for residents in Yangon, 5.1% in Pa-an and none in Bago. Consumption of calcium-rich foods, particularly milk and milk products, should be encouraged among the Myanmar people. Towards this end, appropriate nutrition education materials should be developed for promotional purposes.

Keywords: Calcium intake, food sources, Myanmar

INTRODUCTION

The emergence of chronic non-communicable diseases is a growing concern in both developed and developing countries and the importance of diet and physical activity on the prevention and control of these diseases is well documented. Realising this fact, the World Health Organization (WHO) has urged the member countries to promote a healthy diet and physical activity programmes (WHO, 2005). Among the chronic non-communicable diseases related to diet, osteoporosis is an importanrt concern. Nutrition plays an important role in offering protection against osteoporosis both by its direct involvement in the development and maintenance of bone mass and by maintaining normal postural reflexes and soft tissue mass (Lysen & Walker, 1997; Ilich & Kerstetter, 2000).

Bone depends upon dietary intake to supply the bulk of materials (calcium, phosphorus, and protein) needed for the

Correspondence author: Phyu Phyu Aung; Email:*aung.phyu@gmail.com*

synthesis of extracellular material. The need for a mineral-rich diet persists even after growth has ceased as calcium (particularly) is lost daily from the body in considerable quantitities, and if this loss is not offset by corresponding inputs from ingested food, the body tears down bony structural units. Calcium is lost through shed skin, hair, nails, sweat, urine and digestive secretions. Thus there is a relationship between low calcium intake and low bone mass, both in respect to failure to achieve the genetically programmed peak mass, and in respect to losses of bone after menopause. The same considerations apply to the other bulk constituents of bone, phosphorus and protein. However, these nutrients are less apt to be present in limiting quantities in modern diets (Heaney, 2000). Whilst there is some documentation on calcium intake and calcium food sources among Asians and Hispanics (Wang, Crawford & Bachrach, 1992; Looker *et al.*, 1993; Chee *et al*., 2002; Lowe *et al*., 2008), there is a lack of such information for the Myanmar population. Although the prevalence of osteoporosis in Myanmar is not known, it is one of the common bone diseases, encountered at the clinics and is also a significant cause of morbidity in older adults (pers. comm.). This has prompted us to conduct the present study with the objective of investigating calcium intake, food sources of calcium, and influencing factors for calcium intake in Myanmar.

METHODOLOGY

Study design and subject recruitment

A cross-sectional community-based calcium intake study was undertaken among the residents aged 2 years and above in Bago Division, Kayin State and Yangon Division of Myanmar.

Multistage sampling was employed to recruit the subjects. Bago Division and Kayin State were purposely chosen to investigate calcium intake among the Bamar and Kayin people, being the two major population groups of Myanmar. Yangon the capital city then was also included in the study. One township each was randomly chosen from Bago Division and Kayin State. Lists of wards (every township of Myanmar is composed of wards) and households from each selected township were obtained from the respective Township Medical Officers. Based on each household list, (one from each township), 60 households (estimating 5 persons in each household) were randomly chosen.

All members of the selected households aged 2 years and above, who gave consent, and were present on the day of the survey were included. In this way, a total of 886 subjects were recruited. The project was explained and informed consent was obtained from the participants. Informed consent was given either by the respondents themselves or the by the parents in the case of children. Dietary assessment was conducted on all members of the selected households.

Sample size (n) was calculated using the formula $n = (z^2 \times pq)\, d^2$, where $z = 1.9$ for 95% confidence and estimated prevalence of low calcium intake was assumed to be 50%, and margin of error was taken as 2%. The required sample size would be 150, or 300 for both sexes. The total would be 900 based on 300 subjects from each of the three study locations namely, Bago Division, Kayin State and Yangon.

A pre-tested structured questionnaire was employed for the collection of socio-demographic and background information of the subjects.

Ethical approval was obtained from the Ethical Board of the Department of Medical Research, Yangon, Lower Myanmar.

Dietary assessment

Combined food diary and 24-hour dietary recall method was employed as per findings from our previous studies (Phyu Phyu Aung *et al.*, 2005). For both 24-hour dietary recall

and food diaries specific forms were developed for filling out.

24-hour recall

A trained interviewer asked the respondent to remember in detail, all the food and drinks they consumed during the past 24 hours. The interviewers prompted the respondents to remember eating and drinking episodes by time periods, or linking to daytime activities. Each subject had to recall food intakes for three days (two weekdays and one weekend). Food models, measuring cups and spoons, bowls, glasses, cups, and plates were used to assist with portion size estimates. Dietary information for the young children and very old adults, who could not express themselves, were obtained through their parents / elder sisters / elder brothers for young children and daughters / nieces for the old subjects.

Food diaries

Respondents were asked to record the types and quantities of food and drink consumed over the past 24 hours in a form provided. Portion sizes were estimated using household measures. Each subject had to record food intake for three days (two weekdays and one weekend, same days as 24-hour recall). For very young and old subjects, the forms were filled by the parents / elder sisters / elder brothers and daughters / nieces respectively.

Recording of food intake by food diary was first done for the first day, followed by 24-hour recall the next morning, requesting them to recall food intake for the same past 24-hours as recorded; this allowed for checking of consistency and validity. The same procedure was carried out for dietary assessment of another weekday and weekend. The subjects were also asked if they took "vitamin and mineral pills" during the period and, if so, what type or brand. None of the subjects were regular users of dietary supplements. Upon completion of the interview, the forms were checked by the Principal Investigator for completeness and errors.

Nutrient database

From the completed forms of food intake, calcium intake was calculated by employing the food composition tables: "Food Composition Table for Use in East Asia" (FAO), "Food composition Table ND.3 for INMUCAL Program (Thailand), "Asia Food Composition Tables" (Thailand), and "Myanma Asarasar and Aharra (Myanmar)". If calcium value for the given food item was not available, calcium content was determined in the laboratory of Nutrition Division, by the colorimetric method (Raghuramulu, NKM & Kalyana-sundaram, 1983). Recommended daily allowance of calcium for different age groups (Myanmar) was used in the calculation of calcium intake as percent of RDA (National Nutrition Centre, Myanmar, 1983).

Data analysis

Each food item included serving size, gram weight, energy value, calcium value, and calcium density values per 100 kcal of food. Foods were sorted and were assigned to food groups. Data were analysed by the Statistical Package for the Social Sciences® Version 14. Analysis of variance was employed for subgroup analyses based on gender, age and location.

RESULTS

A total of 886 subjects (423 from Yangon, 241 from Pa-an, and 222 from Bago) completed three days of food diaries and 24-hour recall for dietary assessment. The age range of the subjects was 2 to 93 years, with 405 males and 481 females.

The socio-demographic characteristics of the study population are presented in Table 1. The majority of the respondents were in the 10-19 years and 20-49 years age groups. Among those who were working,

Table 1. Socio-demographics of the study population

	Male *N (%)*	*Female* *N (%)*
Age in years		
2-9	75 (18.5)	62 (12.9)
10-19	149 (36.8)	156 (32.4)
20-49	120 (29.6)	174 (36.2)
≥ 50	61(15.1)	89 (18.5)
Total no of respondents	405	481
Occupation of working respondents		
Government Service	6 (3.5)	9 (4.2)
Self-Employed	22 (12.9)	29 (13.7)
Private Companies	15 (8.8)	34 (16.0)
Sales / Farmer	37 (21.6)	44 (20.8)
Kyaban (No fixed job)	24 (14.4)	11 (5.2)
Others	1 (0.6)	1 (0.5)
*Total	105	128
Education		
Illiterate	20 (8.5)	13 (4.7)
Less than primary school level	22 (9.4)	34 (12.3)
Primary School level	26 (11.1)	35 (12.7)
Secondary School level	85 (36.2)	84 (30.4)
High School Level	67 (28.5)	67 (24.3)
Graduate & above	15 (6.4)	43 (15.6)
*Total no. of respondents	235	276

*excluding students & children <5 years

majority were in the private sector. They were self-employed, salary earners in private companies, sales / farmers working in a shop / farm owners, or kyaban (with no fixed jobs). Most of the respondents (excluding students and children less than 5 years) attained secondary or high school level of education. There were more graduates among the female subjects compared to the males.

Table 2 shows the mean calcium intake of the study population. It was lowest in the 2-9 years age group and highest among the 20–49 years in both sexes, except in males in Yangon. Mean Ca intake of males was higher than for females in general. For males, in the age groups 20–49 and ≥50 years, those residing in Pa-an had significantly higher intake than those from Bago and Yangon. For females, a significant difference was only found among the 10–19 years age group, again highest in those from Pa-an. When calcium intake was expressed as Ca density in energy (mg of calcium intake / 100 kcal intake), the values obtained for the 2–9 years and 10–19 years age groups in males and 10–19 years group in females were significantly different among the study areas.

Mean calcium intake as percent of RDA is presented in Table 3. Calcium intake of all the age groups was found to be much less than the recommended levels (RDA for Myanmar) with the exception of the 20–49 age group of both sexes from all three areas and subjects 50 years and above in Pa-an

Table 2. Mean calcium intake (mg / day and as Ca density in energy) by sex, age group, and geographic location

Age Group	*Yangon Division* (n = 423)	*Pa-an State* (n = 241)	*Bago Division* (n= 222)	*Total* (n=886)	*p*
		Mean calcium intake ±SE (mg / day)			
Male					
2-9 y	184±19 (22)	232±30 (19)	190±19 (34)	197±13(75)	0.33
10-19 y	400±27 (83)	470±54 (45)	399± 45 (21)	421±23 (149)	0.38
20-49 y	331±22 (60)	500±53 (31)	433± 41 (29)	399±21 (120)	0.002
≥50 y e	319±27 (36)	546±67 (10)	426±51 (15)	383±25(61)	0.002
Female					
2-9	211±27 (23)	258±64 (10)	187±18 (29)	207±17(62)	0.32
10-19	299±16 (62)	436±33 (74)	313±41 (20)	366±19(156)	0.001
20-49	372±26 (84)	450±31 (37)	367±24 (53)	387±16 (174)	0.12
≥50 y e	297±23 (53)	419±54(15)	339+ 38(21)	327 +19(89)	0.058
		Calcium density in energy (Ca intake in mg / day per 100 kcal intake)			
Male					
2-9 y	13.0±1.0 (22)	18.6±2.1 (19)	20.3±2.2 (34)	17.7±1.7 (75)	0.034
10-19 y	15.3±1.1 (83)	19.9±2.0 (45)	21.0+2.3 (21)	17.5±1.7 (149)	0.026
20-49 y	15.8±1.2 (60)	18.3±2.1 (31)	18.2±1.3 (29)	17.0±1.5 (120)	0.35
≥50 y e	17.7±1.9 (36)	18.75±2.0 (10)	22.5±3.0 (15)	19.1±2.2 (61)	0.38
Female					
2-9 y	16.5+1.8 (23)	18.8±3.7 (10)	17.8±1.8 (29)	17.5±2.1 (62)	0.81
10-19 y	14.6±0.78 (62)	19.4±1.3 (74)	19.6±2.1 (20)	17.5±1.2 (156)	0.008
20-49 y	19.5±1.4 (84)	20.2±2.8 (37)	22.0±2.7 (53)	20.4±2.1 (174)	0.62
≥50 y	17.6±1.1 (53)	22.5±2.8 (15)	21.9±2.4 (21)	19.4±1.7 (89)	0.06

Figures in parenthesis are total number of subjects in their respective age groups

and Bago. Also calcium intake in percent of RDA was lowest among the 2–9 years age group (Table 2). When mean calcium intake was expressed as percent of DRI, as set by Food and Nutrition Board of National Academy of Sciences (FNB, 1997), it was very low in all age groups of both sexes in all three study areas.

Food sources of calcium of the Myanmar people is shown in Figure 1. Overall, the main source of calcium was fish paste, followed by meat, fish, beans and snacks. Calcium from milk contributed only 3% of total calcium intake. In Yangon, calcium was provided mainly by snacks and meat / fish, bean, and egg group. In Pa-an and Bago, fish paste was the main contributor of calcium.

Table 4 presents the factors influencing daily calcium intake. A model with core demographic variables of this study showed that residence location , sex, family income, and father's education for adolescents significantly contributed to calcium intake. Residing in Pa-an, a higher family income (for both adolescents and adults), and higher educational attainment of the fathers (for adolescents) were positively associated with daily calcium intake while being female was negatively associated with calcium intake.

DISCUSSION

Mean calcium intake of our study population is low compared to other studies conducted on Asians, Whites, and Hispanic as shown

Table 3. Mean calcium intake as percent of RDA

Age Group/ Division	*Yangon Division*	*Pa-an State*	*Bago*	*p*	*RDA*
Mean calcium intake as percent of RDA (Myanmar)					
Male					
2-9	46 (22)	57.9 (19)	47.4 (34)	0.33	400
10-19	66.6 (83)	78.3 (45)	66.6 (21)	0.38	600
20-49	82.8 (60)	124.9 (31)	108.2 (29)	0.002	400
≥50 y	79.7 (36)	136.5 (10)	106.5 (15)	0.002	400
Female					
2-9	52.6 (23)	64.6 (10)	46.6 (29)	0.32	400
10-19	49.8 (62)	72.7 (74)	52.1 (20)	0.001	600
20-49	92.9 (84)	112.4 (37)	91.7 (53)	0.12	400
≥50 y	74.1 (53)	104.7(15)	84.6(21)	0.06	400
Mean calcium intake as percent of DRI (Food & Nutrition Board)					
Male					
2-9	26.3 (22)	33.1 (19)	27.1(34)	0.33	700
10-19	30.7 (83)	36.1 (45)	30.7 (21)	0.38	1300
20-49	33.1 (60)	50.0 (31)	43.2(29)	0.002	1000
50 & above	26.6 (36)	45.5 (10)	35.5 (15)	0.002	1200
Female					
2-9	30.1 (23)	36.9 (10)	26.6 (29)	0.32	700
10-19	23.0 (62)	33.5 (74)	24.1(20)	0.001	1300
20-49	37.2 (84)	45.0 (37)	36.7 (53)	0.12	1000
50 & above	24.8 (53)	34.9 (15)	28.2 (21)	0.06	1200

(DRI = Dietary Reference Intake)
Figures in parenthesis are total number of subjects in their respective age groups

below (Novotny *et al.*, 2003; Henderson, 1994; Feskanich,Walter, & Graham, 2003; Chee *et al*., 2002 ; Rajeshwari *et al*, 2004; Lowe *et al.*, 2008).

In our study, calcium intake of the people residing in Pa-an was highest followed by those of Bago. Those living in Yangon had the lowest calcium intake. Most of the Kayin population in Myanmar reside in Pa-an and Kayin are very fond of consuming fish paste, which was found to be the major source of calcium in Myanmar. Fish paste is least eaten by Yangon dwellers.

When compared with other studies that included Asians as a sub-population (Wang *et al*., 1992; Novotny, 2003) or Asian population (Iso *et al.*, 1991; Morikawa *et al.*, 2002; Chan, 1996; Chee *et al.*, 2002), the calcium intake of the Myanmar people was considerably lower. This could most probably be explained by the very low intake of milk and milk products (only about 3% of total) in our population, while in the Chinese population in Malaysia, dairy products contributed to 26% of total calcium intake.

Calcium intake of post-menopausal women from Pakistan and the adult population from rural Thailand were as low as our study population (Lowe *et al*., 2008; Pongchaiyakul *et al.*, 2008). They also had a very low consumption of dairy products. In rural areas of Thailand, the major food sources of calcium was glutinous rice, small animals with edible bones, and fresh and

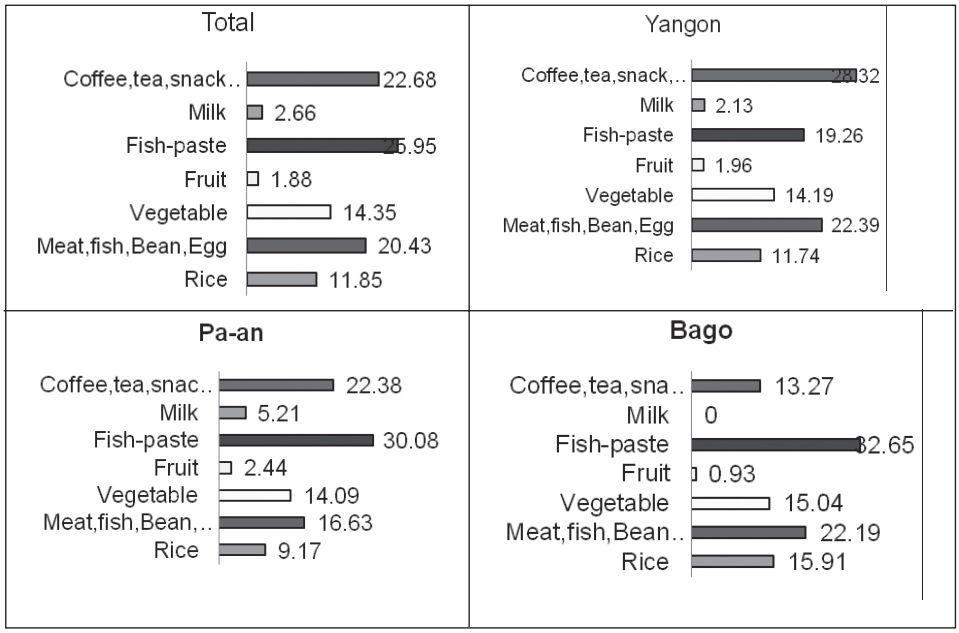

Figure 1. Sources of calcium intake (mg) (total and by geographiclocation

Table 4. Factors influencing daily calcium intake (mg / day), multiple regression (adolescents and adults)

Model	*Beta*	*SE*	*t-value*	*Sig*
Adolescents				
1 (Constant)	116.82	124.47	0.94	0.35
Residence location	85.65	34.37	2.49	0.014
Sex	-63.89	27.32	- 2.34	0.02
Schooling / no schooling	-1.09	2.03	- 0.54	0.59
Father's occupation	7.34	8.05	0.91	0.36
Father's education	28.73	13.53	2.12	0.035
Mother's occupation	-15.27	8.42	- 1.82	0.071
Mother's education	-13.73	14.84	- 0.97	0.34
Family income group	2.50	0.74	3.38	0.001
Adults				
1 (Constant)	373.95	90.96	4.11	0.000
Residence location	32.70	14.92	2.19	0.029
Sex	-53.44	25.70	- 2.08	0.038
Age group	-1.79	17.55	- 0.10	0.92
Occupation	-7.83	8.82	-8.87	0.38
Education	6.06	9.20	0.659	0.51
Family income group	0.95	0.34	2.89	0.004

fermented fish (similar to fish paste of Myanmar).

Similar to studies abroad, males consumed more calcium than females in the present study (Novotny *et al.*, 2003; Rajeshwari *et al.*, 2004). When adjusted for energy intake, values for people living in Pa-an were again higher than those of other two areas. As females consumed less energy than males, calcium density in energy for most of the groups was higher than males, although the actual calcium intake was lower than males. In Novotny's study (Novotny *et al.*, 2003), differences between groups disappeared when calcium intake was expressed as calcium density in energy. In the study by Rajeshwari *et al.*(2004), calcium intakes (unadjusted for energy) were also higher among males than females. When making nutrient comparisons between age and gender groups, it is important to consider energy intake. Since males consume greater quantities of food than females relative to their body size, it is more likely they will meet the recommended daily allowance.

Calcium intake of less than 80% of RDA (Myanmar) was found in the 2-9 and 10-19 years age groups. Considering the fact that skeletal growth occurs during puberty and by age 17, 91% of adult skeletal volume is formed (Finn, 1998), it is of utmost importance that the calcium intake of Myanmar adolescents be increased. The RDA for calcium of Myanmar is much lower compared to values of Food and Nutrition Board, National Academy of Sciences as shown in Table 3. When compard with the reference RDA values for the Asian population (from 500 to 1000 mg / day for various age groups) (FAO / WHO, 2002), our RDA values are also much lower. The Myanmar RDA for calcium was set in 1983 and did not take into consideration levels needed to prevent osteoporosis, as was the case for the development of DRI for calcium (Food and Nutrition Board, 1997). When we compared the calcium intake data with the DRI values, the calcium intake of our population was very low for all age groups for both sexes. Although the precise quantity of calcium required to realise the full benefit at each life stage cannot be unambiguously determined, recommended daily allowance of calcium that has been set for Myanmar is much lower than the set values of FNB; this is especially noted for older age groups.

In the present study, calcium source was mainly from fish paste although in Yangon, the major source was from snacks. Those residing in Pa-an consumed more calcium than those of the other two areas, apparently due to a higher intake of fish paste. Milk contributed very little to total calcium intake despite the fact that milk is a very rich source of calcium. This implies that the study population consumed very small amounts of milk and milk products. Based on the study on adult Chinese and Japanese, 23% to 24% of their diet is contributed by dairy products. In white populations, this value has been estimated to be 70% (Novotny *et al.*, 2003). Wang *et al.* (1992) found differences in food and beverage sources of calcium by ethnic group. Low fat milk was selected by whites more frequently than by African Americans; bread, cereals, vegetables and legumes were important sources of non-dairy calcium for Asians, whose concumption dairy of dairy products is generally low (Wang *et al.*, 1992).

Higher family income, being male sex, and higher educational attainment of fathers had a significant association with a higher intake of calcium. The finding of a higher calcium intake by males and those with a higher family income group were most likely due to their higher total energy and other nutrients intake. A similar finding was found in the study by Novotny *et al.* (2003).

In conclusion, the authors would like to emphasise the existence of a high prevalence of low calcium intake of our people which can lead to deleterious effects on bone health and quality of life. Irrespective of income, milk and milk products are not the regular

foodstuff of the people of Myanmar. Effective nutrition education channels and materials should be used to encourage the Myanmar people to consume milk regularly. Milk and milk products are readily available and not expensive in Myanmar, particularly in the rural areas where households rear cows. Calcium supplementation can be used as an alternative measure, especially for those who do not like to take milk and milk products, to improve their calcium intake. The cost of calcium supplement (as calcium carbonate) is quite low in our country.

There are a number of limitations to the present study. Measuremnt of dietary calcium intake from a 3-day record might not reflect long-term consumption and might be of insufficient length for a reliable assessment of calcium intake. A better mean intake could be obtained by a 7-day record, but then it would be very difficult to conduct a dietary assessment survey on the same houses for a period longer than 3 days. There could be errors in the food recall recorded through a 2nd party for the very young and old subjects, but that was the best we could do to assess the calcium intake, given the logistic and financial constraints. Geographically, Myanmar can be divided into coastal, delta, and hilly regions. Our study areas did not include the hilly regions due to logistic reasons. Thus the results of our study might not be representative of the population residing in the hilly regions, as the nature of food intake tends to vary from region to region. It is suggested that further studies on the calcium intake of the population residing in the hilly regions be undertaken.

ACKNOWLEDGEMENTS

The authors would like to thank the Director General, Department of Medical Research (Lower Myanmar) for permission to conduct the project and staff of Nutrition Research Division of the Department of Medical Research (Lower Myanmar) for their participation in the survey.

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