Calcium Consumption for Osteoporosis Prevention: Knowledge, Attitudes and Behavior in the Northeastern Region, Thailand

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Objective: Identified Thai adults' knowledge and attitudes towards calcium and determined factors predicting calcium consumption.

Material and Method: One thousand four hundred seventy five Thai adults, aged ≥20 years old were interviewed, using a semi-structured questionnaire. Knowledge about role of calcium and good sources of calcium was measured using 17 questions. Attitudes towards calcium were measured with 10 opinion statements, using 7-point Likert scale (1 = strongly disagree to 7 = strongly agree). Calcium consumption, based on a 24-hour recall, was assessed using food frequency checklists and open-ended questions.

Results: The median score for knowledge was 15 (IQR: 12, 16; total possible score: 17). The overall median of attitudinal score was 5.6 (IQR: 4.9, 6.1; cronbach's alpha = 0.80). Approximately 10.9% consumed adequate amounts of calcium (800 mg/day).

Conclusion: Factors significantly determining the likelihood an adequate intake of calcium were age <35 years, support from peers and taking calcium-supplements.

Keywords: Calcium, Calcium consumption, Knowledge of calcium, Attitude toward calcium, Osteoporosis prevention, Thai communities

An adequate intake of calcium is crucial for both development of bone mass in teenagers[1] and maintenance of bone mass throughout life and as a consequence, preventing osteoporosis[2]. Low calcium consumption has long been reported from various countries[3,4] including Thailand[5,6]. In 1962, an international calcium intake survey showed that the lowest calcium intakes were found in Thailand and Colombia (266 and 240 mg/day)[6]. The results from more recent studies emphasized that low calcium consumption is still a problem in Thailand. Three studies, conducted between 2002 to 2003, showed the mean dietary calcium intake was 265 mg/day in suburban area[7] and 361 mg/day in the capital of Bangkok[8], and the amount of calcium consumed by post-menopausal women in rural areas (166±92 mg/day)[7] was far below that consumed by post-menopausal women in Bangkok (429±248 mg/day)[9]. Another study, conducted in 2008, found that only 6% of males and 3% of females reached Thai daily recommendation intake (TDRI) for calcium which is 800 mg/day[9]. Given the predicted increase in the proportion of the population aged 60 and over in Thailand[10] in the coming decades, the prevalence of inadequate calcium consumption will become a major health problem in Thailand.

To address the problem of malnutrition and inadequate intake of calcium, the government program to provide free milk for students in primary school across Thailand was established in 1992[11]. However currently, there is no national program to address inadequate intake of calcium among adults and the elderly. While promoting frequent intake of milk and dairy products is a strategy used in western countries to tackle calcium deficiency, it may not be appropriate for Thailand. It should be noted that most Thais stop drinking milk when they reach adulthood, as milk is

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culturally considered a "children's food". In addition, dairy products are not a common ingredient in Thai cuisine.

Although previous studies in Thailand clearly indicated that calcium consumption among Thai adults is insufficient, none has investigated knowledge about calcium and attitudes toward calcium or patterns of calcium consumption. In addition, in order to plan an effective program to promote calcium consumption among Thai adults, it is necessary to identify key factors predicting calcium consumption.

Hypothesis

Based on the review of the literature and our previous qualitative survey, it was hypothesized that the following 11 factors may determine an adequate intake of calcium. These were five socio-demographic factors (age, gender, area of living, educational attainment, income), one health-related factors (having osteoporosis or osteopenia), two cognitive factors (knowledge about role of calcium and good sources of calcium, and perceived TDRI for calcium), and three psychological factors (attitudes toward calcium, support from peers, and perceived behavioral control). The present study also controlled for consumption of calcium supplement tablets.

Material and Method
Participants

The northeastern region of Thailand was chosen as the study area because this region was reported to have the highest prevalence of low calcium consumption in Thailand[5]. Of the 20 provinces in this region, Khon Kaen, which is the main province and is considered the headquarters of this region, was therefore selected. Its population aged 20 years old and more was 1,284,183 people[12]. The sample size was determined by the minimum number of subjects required for multiple regression, using the formula suggested by Sokal and Rohlf[13] and taking into account of the design effect due to cluster sampling:

$$n_1 = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2}{C(r)^2 + 3}$$

Given that $\alpha = 0.05$, $1-\beta = 90\%$, $r = 0.4$ (based on the result from pilot study), the n_1 obtained from this formula was 355. The design effect of 4 (2 for each stage where cluster sampling was employed) was used to adjust number of subjects. Therefore, at least 1,420 subjects were needed for the present study. Method of subject recruitment being employed was a multi-stage sampling, taking into account the
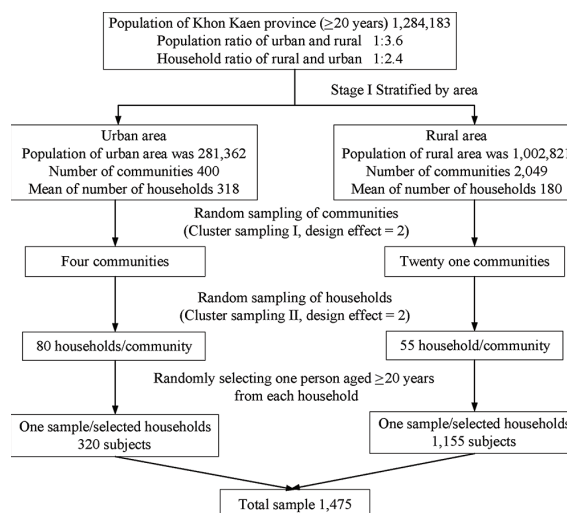

Fig. 1 Subject recruitment process.

population ratio and the household ratio between rural and urban areas (Fig. 1).

Questionnaire

A structured interview questionnaire was used as the research tool. Questionnaires were read to the participants by either the researchers, or research assistants. This technique was chosen because a large proportion of participants were either illiterate or had difficulty in reading. Prior to commencing the study, all research assistants were trained on application of the protocol to ensure consistency of data collection. The research protocol was approved by the Khon Kaen University Ethics Committee for Human Research. On the average, the participants took approximately 30 minutes to complete the questionnaire.

The questionnaire was developed by authors, as the authors were not aware of any existing tools that were suitable for collecting data for the purpose of the present study. The relevant literature was used to inform questionnaire development. Prior to being administered, the questionnaire was assessed for content validity by five experts. It was also pre-tested with 50 subjects in the urban and rural areas of Nakon Racha Sima province, a neighboring province, to assess for language clarity. The questionnaire was written in Thai language. Details on how to measure knowledge, psychological variables, and consumption behaviors are as follows:

Measurement of knowledge of calcium

Knowledge of calcium was measured using 17 questions. Each question was provided with three

choices, "Yes", "No" and "Don't know". Each correct answer received score of 1. The questions consisted of two themes, (1) Role of calcium in the body: 7 questions, and (2) Good sources of calcium: 10 questions.

Measurement of perceived TDRI for calcium

The amount of TDRI for calcium was asked with one question "Do you know the minimum amount of calcium that is recommended for Thai adults to take in a day?" In addition, those who answer "yes" were required to specify the amount.

Measurement of attitudes

Attitudes towards calcium were measured using 10 opinion statements on two dimensions, i.e. attitude towards the role of calcium in the body (7 items) and attitude towards necessity of taking calcium regularly (3 items). Participants were asked to identify their degree of agreement to each statement on a Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree).

Measurement of support from family members and peers, and perceived behavioral control

Situational statements were used to measure support from family members and peers (4 items), and perceived behavioral control (4 items). These two variables were measured in terms of how frequently each situation occurred. The frequency scale ranged from 1 (almost never) to 7 (almost always).

Measurement of behaviors and estimated amount of calcium being consumed in a day

Calcium consumption was measured based on a 24-hour recall. Participants were asked to report everything they had consumed the day before the interview including the quantity. Data were entered into an Imucal program to estimate the amount of calcium being consumed.

Statistical analysis

Descriptive statistics were produced to describe characteristics of participants. Logistic Regression was used to identify factors influencing calcium consumption. Prior to performing the analysis, five dependent variables, i.e. income, knowledge, attitudes, support from family members and peers, and perceived behavioral control, were dichotomized into (1) score or value less than median and (2) score or value equal or greater than median. All p-values presented are two-sided test and a $p < 0.05$ was considered statistically significant. Statistical analysis was performed with SPSS version 11.5.

Ethical approval

The study was approved by the Khon Kaen University Ethics Committee for Human Research. The participants were purely voluntary.

Results

One thousand four hundred seventy five people were interviewed. The mean age of the respondents was 43.3 (SD: 13.6) years (range 20-89 years). The median income per month was 6,000 Baht (IQR: 300, 10,000). The socio-demographic characteristics of the respondents are shown in Table 1.

Most respondents (66.0%, n = 974) had received information or instruction about calcium, however 87.5% (n = 1,290) expressed interest in receiving more information. Only 2.2% (n = 33) reported that they were diagnosed as having osteoporosis or osteopenia.

Most of respondents (89.1%, n = 1,314) consumed less than the TDRI (800 mg/day) of calcium. In other words, only 10.9% consumed adequate amounts of calcium. Approximately 6.9% (n = 102) took calcium supplement on regular basis. When consumption of calcium supplements was categorized by health condition, it was also found 45.5% (15/33) of respondents having osteoporosis or osteopenia consumed calcium supplement on regular basis while only 6.0% (87/1,442) of respondents not having osteoporosis or osteopenia consumed this supplement on regular basis. The average amounts of calcium consumption categorized by socio-demographic characteristics of the respondents are shown in Table 1.

The overall median score for knowledge was 15 (IQR: 12, 16) out of a possible score of 17. Most respondent were aware of the function of calcium (median 6, IQR: 6, 7) and could identify sources of calcium (median 9, IQR: 7, 9) (Table2). Only 4.6% (n = 68) of the respondents were able to specify the TDRI for calcium correctly.

The internal consistency of the scale of attitudes towards calcium consumption was 0.80. The overall median of attitudinal score was 5.6 (IQR: 4.9, 6.1), suggesting that overall respondents expressed positive attitudes towards the role of calcium in the body and the need to take calcium regularly (Table 3).

Table 1. Characteristics of respondents and calcium consumption

Variables	Frequency (%) (n = 1,475)	Population (%) (n = 1,284,183)	Median (IQR) of calcium consumption in mg/day (n = 1,373[a])
Age (years)			
20-34	414 (28.1)	413,769 (32.2)	293 (218, 509)
35-49	583 (39.5)	449,719 (35.0)	262 (140, 426)
50- and older	478 (32.4)	420,695 (32.8)	262 (140, 387)
Gender			
Female	808 (54.8)	657,638 (51.2)	273 (140, 448)
Male	667 (45.2)	626,545 (48.8)	262 (140, 426)
Area of living			
Rural	1,154 (78.2)	1,002,821 (78.1)	262 (140, 428)
Urban	321 (21.8)	281,362 (21.9)	280 (149, 474)
Educational attainment		N/A	
Primary level (grade 1-6)	569 (38.6)		262 (140, 415)
Secondary level (grade 7-12)	645(43.7)		262 (140, 411)
Higher than secondary level	261 (17.7)		297 (202, 535)
Income per month (Baht)[b]		N/A	
≥ Median (6,000)	680 (46.1)		262 (140, 415)
< Median (6,000)	795 (53.9)		270 (140, 489)

[a] Respondents not taking calcium supplement
[b] Approximately 30 Baht = $1US
N/A = not available

Table 2. Distribution of correct responses to each knowledge item (n = 1,475)

Questions	Frequency (%)
Which of the following items are good sources of calcium?	
Milk	1,420 (96.3)
Small fish including bone	1,352 (91.7)
Soybean milk[a]	1,275 (86.4)
Sesame seed	1,250 (84.7)
Green vegetable	1,237 (83.9)
Dried shrimp	1,211 (82.1)
Yogurt	1,181 (80.1)
Tofu drink[a]	1,178 (79.9)
White hard tofu	896 (60.8)
Energy sport drink[a]	773 (52.4)
Which of the following are the roles of calcium to the body?	
Repair the bone	1,407 (95.4)
Promote bone formation	1,380 (93.6)
Strengthen bone and prevent bone fracture	1,367 (92.7)
Prevent osteoporosis	1,359 (92.1)
Prevent loss of height in height when getting old	1,166 (79.1)
Prevent stooped posture with a bent back when getting old	1,073 (72.7)
Cause fragile bone[a]	1,309 (70.4)

[a] The correct answer is "no"

The internal consistency of the scales of support from family members and peers, and of perceived behavioral control were 0.95 and 0.93 respectively. The overall median of frequency of support from family members and peers was: 4.3 (IQR: 3.0, 5.2) and of perceived behavioral control was 4.3 (IQR: 3.5, 5.5) suggesting that only approximately 25% of the respondents frequently received support from family members or peers and approximately the same proportion of the respondents perceived that they were frequently able to force themselves to consume calcium.

The logistic regression model showed that of 11 factors being studied, as listed in hypothesis section, age and support from peers were significantly associated with an adequate intake of calcium. It is not surprising that taking calcium supplement showed to have the strongest association with consuming calcium up to 800 mg/day. Among respondents who took calcium supplements, a median calcium intake in a day was 1,124 mg (IQR: 819, 1,512), and among respondents who did not take calcium supplements was 270 mg (IQR: 140, 474). After controlling for support from peers and consumption of calcium supplement tablets, individuals aged 20-34 years were 2.1 times more likely to consume calcium up to 800 mg/day than individuals aged ≥50 years (adjusted OR 2.1, 95% CI:

Table 3. Attitudes towards calcium (n = 1,475)

	Opinion statements	Level of agreement[a] (%)						
		1	2	3	4	5	6	7
1	Calcium prevent osteoporosis	1.8	1.2	0.4	3.4	11.2	30.8	51.3
2	Calcium prevents a stooped posture when I am old	1.2	1.2	0.7	8.4	15.2	35.2	38.1
3	Calcium prevents my bone being broken when I fall	1.7	1.8	0.9	4.8	15.0	32.3	43.5
4[b]	Consuming calcium daily causes me suffer from flatulence	23.5	15.3	12.9	29.0	7.7	6.8	4.7
5[b]	Calcium may harm my internal organs	27.0	16.8	11.2	26.5	7.9	6.4	4.3[b]
6[b]	I often feel sick and nausea after consuming calcium	28.4	17.2	10.6	27.8	5.9	6.6	3.5
7[b]	Consuming calcium regularly will make stones form in my urinary tract	21.1	15.5	13.3	31.8	5.8	7.3	4.9
8	I must consume calcium every day because my body needs it every day	1.7	1.2	1.5	8.2	19.8	31.2	36.4
9	Consuming calcium regularly is necessary for my body	1.2	1.1	1.1	8.1	18.4	32.7	37.5
10	I need to consume calcium regularly otherwise my body will not obtain sufficient calcium	1.8	2.0	1.9	11.9	21.2	33.0	28.3

[a] Level of agreement: 1 (strongly disagree), 2 (moderately disagree), 3 (slightly disagree), 4 (neither agree nor disagree or not sure), 5 (slightly agree), 6 (moderately agree) or 7 (strongly agree)
[b] Their scales were reversed prior to calculating the Cronbatch's alpha and the average of the attitudinal score
Statements 1-7: attitudes towards the role of calcium in the body, statements 8-10: attitudes towards necessity of taking calcium regularly

1.3, 3.5). After controlling for age and consumption of calcium supplement tablets, individuals who frequently received support from peers were 2.5 times more likely to consume calcium up to 800 mg/day than individuals who did not frequently receive support from peers (adjusted OR 2.5, 95% CI: 1.7, 3.7) (Table 4).

Of 1,373 respondents who did not take calcium supplement on regular basis, 80.6% (n = 1,107) obtained calcium from vegetables (i.e. winged bean, ivy gourd, kale, and Chinese cabbage), 6.9% (n = 95) from sesame seeds, 54.9% (n = 754) from milk and dairy products and 46.0% (n = 632) from bone of small fishes.

Discussion

The present study is the first in-depth investigation of the knowledge, attitudes, and behaviors of the northeastern Thai population, in the aspect of calcium consumption, and osteoporosis prevention.

Whilst a majority of respondents was aware of the importance of calcium to the body and good sources of calcium, they were still not aware of the TDRI for calcium. It should be noted that in Thailand, a sizeable number of advertisements for milk mention the benefit of calcium but none of them mention the recommended amount of calcium to be taken in a day. Approximately 40% of the respondents were not aware that white hard tofu is a good source of calcium. In addition, approximately half of the respondents

Table 4. Factors influencing calcium consumption (n = 1,475)

Factors	Crude OR (95% CI)	Adjusted OR (95% CI)
Age (years)		
≥50	1.0	1.0
35-49	0.8 (0.5, 1.1)	1.2 (0.7, 1.9)
20-34	1.0 (0.7, 1.5)	2.1 (1.3, 3.5)
Taking calcium tablets		
No	1.0	1.0
Yes	32.7 (20.4, 52.4)	34.4 (20.8, 57.1)
Support from peers		
< median	1.0	1.0
≥ median	2.3 (1.6, 3.2)	2.5 (1.7, 3.7)

95% CI = 95% confidence interval; OR = odds ratio

misunderstood that energy sport drink was a good source of calcium.

Attitudes towards calcium were generally positive. Similar attitudes towards the use of calcium and osteoporosis prevention have been reported in previous studies in Thailand[14] and other countries[3]. Although this group of the Thai population was in favor of taking calcium supplement on a regular basis, they appeared to be less disciplined in adhering to regular calcium consumption. In addition, there seemed to be insufficient support for calcium consumption from family members and peers.

The most common sources of calcium for Thai people were found to be vegetables, which contain lower concentrations of calcium than dairy products. As previously reported, the quality of the respondents' diet and the total daily calcium intake was significantly lower than the Thai daily recommendation of 800 mg/day[5]; this put many at risk of calcium deficiency. In addition, many vegetables in Thailand are known to contain calcium anti-nutrients, for example, phytate, and oxalate, which may affect calcium absorption. As heat is able to remove these substances[15], instruction on appropriate cooking processes should be included in programs to promote calcium intake, especially programs that target those who rely on obtaining calcium from vegetables.

The proportion of persons who consumed calcium ≥ TDRI found in this study was slightly higher than that reported in a previous study[5]. While previous studies found the average dietary calcium intake to be one third of the TDRI, the present study showed that there was a large difference between the average dietary calcium intake among those taking calcium supplements and those who did not. Logistic regression also confirmed that taking calcium supplements is the major factor predicting the sufficient intake of calcium.

Unsurprisingly, respondents who had established osteoporosis or osteopenia were more likely to be taking calcium supplements. This suggests that they are in contact with a health team during screening/diagnosis, which affords an opportunity to help educate people about the importance of consuming calcium supplements to help prevent/manage osteoporosis. This relationship was illustrated in two studies in the USA that found that providing information relating to bone density and taking a bone scan increased calcium consumption and influenced a better quality of diet[16,17].

Older respondents appeared to consume less calcium than younger respondents. Although younger people eat more calcium, their average calcium intake per day was still far below the TDRI. This finding strongly supports the need to promote dietary calcium consumption among Thais, especially among adolescents who are the target of osteoporosis primary prevention intervention, i.e. optimization of peak bone mass[18]. A study that used computer modeling estimated that if the adolescent peak bone mass is 10% higher than the mean, the development of osteoporosis is likely to be delayed by 13 years[19].

Given that support from family members and peers was found to significantly determine the chance of obtaining calcium up to 800 mg/day, it is imperative that a program to promote calcium consumption should also target the family and friends of those who were at risk of calcium deficiency.

The result from logistic regression analysis did not support the hypotheses that the present study have posed that those having knowledge about calcium or knowing the TDRI for calcium would be more likely to consume a sufficient amount of calcium. One possible explanation is that respondents who knew the TDRI for calcium did not know how much of each calcium-containing food they needed to eat in order to reach 800 mg.

Several health behavior models[20] identify attitudes and perceived behavioral controls as key determinants of health-related behavior, our study was not able to demonstrate the associations between these two variables and calcium consumption.

Although several other health-related behavior studies found that women adhere to desirable health-related behavior more than men[21,22], the difference found in the present study was not significant. As in the last decade, it has become apparent that osteoporosis is also common in men[23,24]. Our finding suggested the need to promote calcium consumption among both genders.

The main strength of the present study was that several steps were taken to minimize potential information bias. First, for all knowledge questions, option "don't know" was provided so that those who did not know the answer need not guess. Second, since the amount of calcium intake was estimated from a self-report of food being consumed, the face-to-face interview was employed so that the type and quantity of food can be identified as precisely as possible. Third, calcium consumption was measured based on a 24-hour recall. This could be seen as strength of the present study as the recall period was short, the information bias due to recall should be minimized. Previous study that collected behavior data based on 24 hours recall was, for example, Bowman SA[25]. On the other hand, this could be a limitation of the study as type of food being consumed may vary by season. Therefore, calcium consumption should be interpreted with caution. The last limitation concerns the generalizability of the results. Since the participants of the present study were from the north-eastern region of the country, the results of the study may not well represent to Thai adults in other regions.

Conclusion

Inadequate calcium consumption was common in both male and female Thai adults. Although they were well aware of good sources of calcium and had positive attitudes towards calcium, the majority of them did not know the Thai daily recommendation intake for calcium. The findings strongly stressed the need to promote calcium consumption among Thais. Future interventions should focus on education about the estimated amount of calcium in common Thai diets, and the encouragement of family members and friends to support one another in preventing osteoporosis through adequate calcium consumption.

What is already known on this topic?

Thai population consumed lower than half of the Thai daily recommendation intake for calcium. Attitudes towards milk and dairy products of Thai population appeared to be positive. Although these products are rich in calcium, they are not common in Thai cuisine.

What this study adds?

The present study found that the main source of calcium for Thai adults was vegetables. The present study also provided in-depth understanding of the Thai adults' knowledge about and attitudes towards calcium. It was found that their knowledge about sources of calcium was satisfactory. However, the majority of them did not know the Thai daily recommendation intake for calcium. Their attitudes towards the role of calcium in the body and the need to take calcium on regular basis were positive. In addition, it was found that the key factor predicting adequate calcium consumption was supports from peer.

Potential conflicts of interest

None.

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ความรู้ ทัศนคติ และพฤติกรรมในการรับประทานแคลเซียมเพื่อป้องกันโรคกระดูกพรุนในภาคตะวันออกเฉียงเหนือของประเทศไทย

เพ็ญนภา ศรีหริ่ง, อีเนส คราส, ทิพาพร กาญจนราช

วัตถุประสงค์: การศึกษานี้มีวัตถุประสงค์เพื่อสำรวจความรู้และทัศนคติต่อการรับประทานแคลเซียมของคนไทยในวัยผู้ใหญ่ และระบุปัจจัยทำนายการรับประทานแคลเซียม

วัสดุและวิธีการ: กลุ่มตัวอย่างคือประชากรที่มีอายุ 20 ปีขึ้นไป จำนวน 1,475 คน ทำการเก็บข้อมูลโดยใช้แบบสัมภาษณ์กึ่งโครงสร้าง ข้อคำถามความรู้เกี่ยวกับบทบาทของแคลเซียมและแหล่งอาหารที่มีแคลเซียม จำนวน 17 ข้อ แต่ละข้อที่ตอบถูกจะได้ 1 คะแนน ทัศนคติต่อแคลเซียมวัดด้วยข้อคำถาม จำนวน 10 ข้อ โดยใช้มาตรวัดแบบลิเคิร์ทสเกล 7 ระดับ เรียงจาก 1 (ไม่เห็นด้วยอย่างยิ่ง) ไปจนถึง 7 (เห็นด้วยอย่างยิ่ง) การรับประทานแคลเซียมวัดโดยใช้แบบสอบถามความถี่การบริโภคอาหารย้อนหลัง 24 ชั่วโมง และคำถามปลายเปิด

ผลการศึกษา: ค่ามัธยฐานของความรู้ คือ 15 (ช่วงอินเตอร์ควอไทล์ 12, 16) ค่ามัธยฐานของทัศนคติต่อแคลเซียม คือ 5.6 (ช่วงอินเตอร์ควอไทล์ 0.87 ค่าสัมประสิทธิ์แอลฟาของครอนบาค เท่ากับ 0.80) พบว่าร้อยละ 10.9 ของกลุ่มตัวอย่างที่รับประทานแคลเซียมได้ถึงเกณฑ์ปริมาณที่แนะนำให้รับประทานต่อวัน คือ 800 มิลลิกรัม

สรุป: ปัจจัยที่กำหนดการรับประทานแคลเซียมได้ถึงเกณฑ์ที่แนะนำ คือ การมีอายุน้อยกว่า 35 ปี การได้รับการสนับสนุนจากบุคคลใกล้ชิด และการรับประทานแคลเซียมเสริม